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BULLETIN

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Lowell Textile Institute

LOWELL, MASS.

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Moody Street and Colonial Avenue

DEPARTMENT

OF

LOWELL EVENING TEXTILE SCHOOL

PUBLICATION OF THIS DOCUMENT APPROVED BY THE COMMISSION ON ADMINISTRATION AND FINANCE

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TRUSTEES OF THE LOWELL TEXTILE INSTITUTE.

LOWELL EVENING TEXTILE SCHOOL.

By Act of the Legislature of 1928, the name of the Lowell Textile School was changed to Lowell Textile Institute, and the evening classes are organized and are to be hereafter operated as a department of the Institute to be known as the Lowell Evening Textile School.

CALENDAR.

1928.

September 27, Thursday	Registration.
October 4, Thursday	Registration.
October 8, Monday	Opening of evening school.
October 12, Friday	Columbus Day — Holiday.
November 29, Thursday November 30, Friday	Thanksgiving recess. No classes.
December 21, Friday	End of first term.

1929.

January 3, Thursday	Opening of second term.
March 8, Friday	Closing of evening school.
April 2, Tuesday	Graduation.

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EVENING CLASSES

GENERAL INFORMATION.

Entrance Requirements.

All applicants to the evening classes must understand the English language and simple arithmetic. Those who are graduates of a grammar or high school are admitted upon certificate. Those who cannot present such a certificate are required to take examination in the subjects of English and arithmetic. In the examination in English a short composition must be written on a given theme, and a certain amount must be written from dictation. In the examination in arithmetic the applicant must show suitable proficiency in addition, subtraction, multiplication, division, common and decimal fractions, percentage, ratio and proportion. Opportunity to register or to take these examinations is offered each year, generally on the Thursday evenings of the two weeks previous to the opening of the evening school.

Registration.

Before entering the class a student must fill out an attendance card, which can be obtained at the office or from the instructors in the various departments.

Any student who has filed an attendance card and who wishes to change his course must notify the office before making the change.

Sessions.

The evening classes commence the second Monday of October and continue for twenty weeks. The school is open on four evenings each week during the period mentioned, except when the school is closed for holiday recesses.

Supplies.

Students must provide their own books, stationery, tools, etc., and pay for any breakage or damage that they cause.

Students' supplies will be sold from the co-operative store every evening school night from 6.45 to 8.15 P.M.

Fees and Deposits.

All evening courses are free to residents of Lowell. To those outside of Lowell the fee is $10 per year for *each course of two nights per week.* Students taking two courses or attending courses requiring more than two nights per week are required to pay $15 per year for three nights and $20 for four nights.

All fees and deposits must be paid in advance.

All students, whether from Lowell or not, taking Course 411, Chemistry and Dyeing Department, are required to make a deposit at the commencement of the course — $5 for first-year students, and $10 for second-year students. A deposit of $10 will be required of all students taking Course 412, 413 or 414. This is to cover the cost of laboratory breakages, chemicals, apparatus, etc., and at the end of the year any unexpended balance is returned, or an extra charge made for the excess breakage.

Every student who takes the chemistry and dyeing course must check up his desk with the instructor of that department when he leaves the school. Any student not doing so will be charged 50 cents.

All students taking Machine-shop Practice will be required to make a deposit of $5. Any unexpended balance remaining at the end of the year will be returned to the student.

Report of Standing.

A report of standing covering the year's work is sent to all students who attend the entire year and take the necessary examinations.

Certificates.

The courses of the evening school are varied and arranged to meet the special needs of those engaged in the industry. They vary in length from one to four years, and at the completion of each course the certificate of the school is awarded, provided, however, that the student has been in attendance in the course during the year for which the certificate is granted.

GENERAL EVENING COURSES

The object of these courses is to give young men of ambition an opportunity to obtain instruction in all the branches of science that are allied with their daily work. For example, one who is employed as a weaver in a textile mill may, by means of the course in manufacturing, obtain knowledge of the manufacture of yarn, the production of a design, and the methods of finishing a fabric, as well as the manner of its weaving or knitting. In like manner the dyer may augment his knowledge of the chemicals and materials he is daily handling. The engineer and machinist may acquire a knowledge of the mathematics, science of mechanics, electricity and drawing that underlie all the work of an engineer.

It is recognized that the interests of such students lie in a particular field of industry, and these courses are designed to bear directly upon the special line, and supplement, as far as possible, the practical work in which the student is engaged during the day.

In a word, any man having a common school education and the ambition to advance in his line may now secure a broad and comprehensive training in the subjects which will be of vital importance to him in obtaining the goal of his ideal.

A description of all courses follows.

COTTON DEPARTMENT.

110. Cotton Yarns — 3 Years.

The *first year* work in cotton yarn manufacture consists of a study of cotton and its preparation for market, followed by a study of opening, picking, carding and combing.

This work consists of lectures on these operations combined with problems that are peculiar to each operation such as the drafts used and the production of each process as well as the amounts of waste made. Special consideration is given to the adjustment and care of these machines and some laboratory demonstration is used to show the manner of adjusting machines for the purpose of controlling the weight of the product, the amount of work done in a day and the control of waste.

Cotton. — Before taking up the details of manufacturing cotton into yarn, a careful study of its physical characteristics is made. The geographical distribution of the areas producing commercial cottons is explained and the characteristics of the cottons produced in each are studied. A general explanation of the cultivation and harvesting of cotton is made, especially emphasizing the effect of agricultural factors on the cotton fiber and how these may serve to complicate manufacturing problems.

The ginning of cotton is considered, showing the yield of lint, the uses of cotton seed and the various types of gins and what cottons are commonly ginned on each.

The intricate system of buying and selling cotton is studied to illustrate the problems a mill may meet in procuring cotton. In this connection, special emphasis is placed on the classification of cottons by staple and by grade.

Opening and Picking. — Instruction in the preliminary operation of opening and picking covers the mechanical construction of the machines, their parts and adjustments, as fully as the manufacturing results accomplished by the machines. This includes such construction details as evener, lap measuring and safety stop motions, grids, cleaning trunks and beaters, also operation details which involve the adjustment for waste, drafts and character of laps. Some time is devoted to mixing in its various phases, showing in addition to improvement in uniformity of the product, how cottons are mixed to obtain definite average prices and how different percentages of color may be obtained by mixing, especially on the pickers.

Carding. — The process of carding is considered one of the most important, and proper time is devoted to the construction and operation of cards that the student may be familiar with the various parts of the card and the function and design of each. The construction and application of card clothing, as well as the methods of grinding, form a part of the work. Some time is given to a discussion of the waste made in carding, the regulation of the amounts of each made and the calculation of the percentages. New and special attachments for various purposes are brought to the attention of the class, illustrating possible ways of improving carding conditions.

Combing. — The preparation of card sliver for combing, by means of the sliver lapper and ribbon lapper, is thoroughly considered. The combing operation itself is studied in considerable detail, emphasizing the general object and operations in combing and the specific means employed by various types of combs in performing the operation. The calculations in this connection involve the drafts and doublings necessary to produce the proper lap for the comb, the proper comb drafts, and the determination of the per cent of noil produced.

The *second year* work includes a study of the drawing and roving processes and the calculations that accompany these operations. It consists of lectures on the machines and demonstration of their adjustment, showing roll setting, draft and twist control, builder adjustment, spacing coils on the bobbin, and tension control.

Drawing. — Under this head is taken up the theory of doublings and their effect upon the quality of roving and yarn. Like previous and subsequent processes the machine construction forms an important part of the work. Proper stress is paid to such subjects as stop motions, drawing rolls and their covering, clearers and evener motions.

Roving Processes. — Under this head are studied the various machines known as the slubber, intermediate, fine and jack fly frames. The relative motion of the various parts of these machines is so complex that a good opportunity is here presented to fix in the student's mind the application of certain mechanical principles that are used in other departments and upon other machines in the manufacture of textile material. With each process of yarn manufacture the systems of sizing and numbering are explained and under this head both the metric and English systems are considered.

During the *third year* the time is devoted to a study of ring and mule spinning, spooling, winding, twisting and reeling. As in previous years, the work consists of lectures and demonstration on the machines. During this year there is also some work done on the combing machine, particularly in the nature of its adjustment. In addition to these subjects, there is some work done in the way of planning the organization of a cotton mill with a view to showing drafts, speeds, productions and number of machines of each kind necessary for the production of a given amount of a certain yarn.

Ring Spinning. — The consideration of spinning yarn by the ring frame method involves a knowledge of the uses to which the yarn is to be put and subsequent methods of handling, that proper roving may be selected, suitable amounts of draft and twist provided, correct size of rings and travelers selected, and building motions suitably adjusted. Yarn defects are studied with reference to the cause and remedy, necessitating references to many of the earlier operations.

Mule Spinning. — This method of spinning is very different from that of the ring frame, and the mechanical details are more complicated. The student is furnished with a new means of producing yarns, and can compare the relative advantages of each method. A thorough understanding of mule spinning is perhaps more a study of mechanical motions and their functions. This results almost invariably in assisting the student to understand previous processes and machines better because of his work on the mule. It is the object to make clear to the student's mind the principles underlying the construction and operation of the parts that control the drawing, twisting, backing off and winding, together with such special motions and devices as are used upon the modern mule.

Spooling and Winding. — The discussions under this head cover the treatment of single yarns, ring or mule spun, in preparation for twisting, comparing the relative merits of spooling with multiple winding on tubes, and beaming for special twisters. Winders are also considered as a means of preparing yarn packages for sale yarns.

Twisting. — Because of the similarity to ring spinning, the emphasis is more on the manufacturing part of the work, although there are a few peculiar features of a mechanical nature. The twisting of various regular ply yarns, the making of numerous fancy yarns and the principles underlying the production of unlimited patterns is taken up here. The use of special twisters and other apparatus for cords and ropes is considered at this point.

112. Cotton Manufacturing — 4 Years.

The Cotton Manufacturing course is designed to give a student a broad knowledge of the manufacture of cotton cloth. To do this he is required to spend three years in the department of cotton yarns, studying cotton and its conversion into yarn. A student taking this course also spends two years in weaving, one on plain and one on dobby weaving. Three years are spent in a study of the art of designing a fabric and the analysis of fabric already constructed. One year is spent in a study of the processes involved in finishing cotton fabrics. For detailed description, see subjects under Yarns, Weaving, Designing and Finishing.

WOOLEN AND WORSTED DEPARTMENT.

210. Worsted Yarns — 2 Years.

During the *first year* instruction consists of a lecture course on the various kinds of wool fibers, trade terms, sorting, scouring, carbonizing, etc., also a course in carding and the calculations involved in the mechanism of the machines, and a course covering gilling and combing and the processes of top making. The *second year* is devoted to detail study of the English and French systems of worsted yarn manufacture.

211. Woolen Yarns — 2 Years.

During the *first year* instruction consists of a lecture course on the various kinds of wool fibers, trade terms, sorting, scouring, carbonizing, etc., also of a course on carding. The *second year* continues the instruction on carding and then takes up a course on the mule and woolen yarn spinning.

Raw Materials. — A study of raw materials which enter into the manufacture of woolen or worsted yarns, or are made into yarns by processes similar to those employed in the manufacture of woolen and worsted yarns, would include silk, mohair, alpaca, vicuna, cashmere, camel's hair and cotton. In connection with these are considered shoddy, noils and extracts.

Wool Sorting. — Familiarity with the various grades and kinds of wool is obtained by lecture. The various characteristics and properties are explained, as are also trade terms, such as picklock, XXX, XX, ½-blood, ⅜-blood, ¼-blood, delaine, braid, etc. Some skill is acquired in the estimation of shrinkage and in judging the spinning qualities.

Wool Scouring. — The object of scouring and the methods employed are explained, and this involves the consideration of the soaps and chemicals used in washing; also the waste products and their utilization. A demonstration of a commercial quantity of wool is scoured by machines that are made similar in operation to regular commercial machines. A study is made of the effect of the hardness of water upon soap. At the same time the use of driers, their operation and regulation, is taken up, and the methods of carbonizing wool, noils, burr waste, rags, etc., are studied and explained.

Burr Picking, Mixing, Oils and Emulsions. — The use of burr pickers in cleaning wool and the use of mixing pickers in making color blends is covered by lecture and demonstration. Under the subject of oils and emulsions are taken up the characteristics of various oils and the means employed to test them.

This work is taken only by those students who are pursuing the Woolen Manufacturing Course.

Carding. — The different systems of carding wool, depending on whether it is to be made into woolen or worsted yarns, are fully explained, as is also the construction, setting and operation of cards. A part of this work consists of a study of card clothing, its construction, application and grinding.

Woolen Mule. — The student studies thoroughly the operation of the mule as a whole, and acquaints himself with the various principal mechanisms, as, for example, the backing off and winding motions, the quadrant, builder-rail, faller regulation, etc.

Top Making and Combing. — This branch takes up, besides the carding of the wool on a worsted card, the preparing processes, backwashing, also gilling of the stock before and after combing. The construction of the gill boxes and combs is studied by lectures. Later, quantities of stock are made into top and then into yarn.

The Noble, Lister and French combs are studied, and the various calculations to determine draft, noiling, productions, etc., are made.

Drawing and Spinning. — The equipment in the laboratory offers opportunity to make worsted yarn by either the Bradford or open drawing system or by the French system. The process includes the various machines in the successive steps of making Bradford spun yarn, and the functions of the different machines are studied. In the latter, or French system, the stock is run through the drawing machines, and the roving spun into yarn on the worsted mule. The same method of studying the mechanism and operations of these machines is followed as in the case of previous methods of instruction. The student by pursuing this course can compare the different methods of yarn manufacture and note the results of each.

With the instruction in spinning by the Bradford system is given work on the twisters and the effects that may be produced.

214. Woolen Manufacturing — 4 Years.

215. Worsted Manufacturing: Bradford System — 4 Years.

216. Worsted Manufacturing: French System — 4 Years.

These courses are arranged to give those engaged in the manufacture of woolens and worsteds instruction in the various branches of the work. It embraces a study of wools and allied fibers and the manner of manipulating from fibers to finished fabric, including all the processes of yarn manufacturing, weaving, designing and finishing. The instruction given in these three courses is the same throughout the four years with the exception of that given in yarns.

During the *first year* lectures are given on wool fibers and the preliminary processes of their conversion into yarns, calculations of the mechanism of the machines and elementary instruction in cloth designing and analysis.

During the *second year,* students selecting the Woolen Manufacturing Course follow a course in carding and mule spinning and continue the first year work in design and cloth analysis. Students taking either of the Worsted Manufacturing courses continue their work in yarns by studying gilling, combing and the processes of top making. More time is given this year to design and cloth analysis.

In the *third year* students continue their instruction in yarn manufacture, design and cloth analysis, and add the subject of weaving to the course.

During the *fourth year* instruction is given in weaving and finishing.

TEXTILE DESIGN AND WEAVING DEPARTMENT.

311. Cotton Design — 3 Years.

During the *first year* instruction is given in elementary designing, starting with all the foundation weaves which may be used in fabrics such as the plain weave, rib weaves, basket weaves, twill weaves, satin weaves, granite weaves, etc. Combination and derivative weaves are made up from the aforesaid weaves. Fancy and figured weaves, in most cases originated by the student, are produced. Color effects, which are so essential in fabrics, obtainable from the different weaves, as stated above, in which the color arrangement of warp and filling create the pattern, are thoroughly considered. Not only the designing but also harness drafting and the making of dobby chains for any type of weave is taken up.

Cloth analysis is considered in conjunction with designing, as a designer must know the kind of a fabric he is designing, what material and what size of yarns are to be used, and how heavy and costly the cloth is to be. The various topics discussed are the sizes or counts of yarns made from all kinds of fibers, such as cotton, woolen, worsted, silk, rayon, jute and yarns made of other vegetable fibers. Their relative length to the pound is determined in the single, two or more ply, mixed yarns, novelty yarns and fancy yarns, in the American or English system. The same is given in the metric system. Problems involving the take-up of yarns in the weaving and finishing processes are given. Samples of cloth are picked apart to determine their weaves and general construction.

In the *second year* cloth analysis and design are combined in lecture and practice, starting with plain and leading into the more fancy cotton dobby fabrics. A great variety of samples of cloth are used in class work to determine ends and picks per inch, shrinkage in warp and filling, and the number of reed and reed widths

necessary for eventual reconstruction. The yarn numbers of warp and filling are determined by aid of fine balances. The amount of warp and filling necessary for a piece of goods is calculated and the weight of a whole piece as well as the number of yards per pound are determined.

In the *third year* more elaborate cloths are considered, both in designing and analysis, cloths in which extra warp or extra filling, or both, are used. Warp backed, filling backed, double, triple or more plied fabrics are taken up, such as marseilles, quiltings, piqué, suspenders, narrow webbings, velveteens, fancy velveteens, velvets, corduroys, Bedford cords, plushes, leno, in fact, anything a student may suggest which might help him in his work.

312. Woolen and Worsted Design — 3 Years.

This course covers the design and analysis of standard woolen and worsted fabrics and is intended for those who wish to specialize in this branch of textile fabric manufacture. Special and fancy fabrics are studied to the extent that time will permit.

During the *first year* instruction is given in the subject of classification of fabrics, use of point or design paper, plain fabrics, intersection, twills and their derivation, sateen, basket and rib weaves, checks and stripes, fancy weaves, including figured and colored effects; producing chain and draw from design, and *vice versa;* extending and extracting weaves.

The analysis of samples is taken up in a systematic manner, illustrating the various cloth constructions for the purpose of determining the design of the weave and the amount and kind of yarns used, and forms the basis of calculation in the cost of reproducing any style of goods. The various topics discussed are reeds and setts; relation and determination of counts of cotton, woolen, worsted, silk and yarns made from the great variety of vegetable fibers; grading of yarns, folded, ply, novelty and fancy yarns; application of the metric system to yarn calculation; problems involving take-up, average counts, determination of counts of yarn, and weight of yarn required to produce a given fabric.

During the *second year* instruction is given in cotton warp goods, blankets, bath robes, filling reversible, extra warp and filling backs, figured effects produced by extra warp and filling, double cloths and plaid backs.

The analysis work follows as closely as possible the type of fabrics taken up in the designing and the reconstruction of these fabrics with the consideration of their shrinkages and composition.

In the *third year* instruction is given in multiple fabrics, chinchilla, Bedford cords, crepon, matelasse and imitations, double plains, meltons, kersey, plush and suitings. At this time also is taken up the construction of designers' blankets, suggestion cards, and the construction of samples.

The construction of new fabrics from theoretical viewpoint together with the construction from suggestion cards is taken up. In connection with this work instruction is given in making cost estimates for both woolen and worsted fabrics.

314. Cotton Weaving — 1 Year.

The course in Cotton Weaving covers instruction on plain looms, Draper Automatic and Stafford Automatic looms. It includes instruction on the construction of shedding and picking motions, take-up and let-off motions together with the operation of the magazines and hoppers and methods of changing shuttle and bobbin. A study is also made of the preparation of warps, beaming, sizing and drawing-in. The Crompton and Knowles Automatic Towel Looms and the various types of box looms, including chain building and work on multipliers, are also considered in this course.

315. Woolen and Worsted Weaving — 2 Years.

This course includes instruction on the Crompton and Knowles loom and takes up general construction, head motions, take-up, let-off, filling stop motion, etc. The preparation of warps, wet and dry dressing, is given in connection with this course.

316. Dobby and Jacquard Weaving — 1 Year.

This course considers the various types of Jacquard heads and dobbies, which includes single cross border dobbies and leno attachments on double lift dobbies,

handkerchief motions, leno weaving, center selvedge motions, filling changing looms, oscillating reeds, lappet motions, various shaker motions, towel and other pile cloth weaving. The course on Jacquard looms includes general construction, card cutting, lacing, repeating, and fixing.

317. Freehand Drawing — 3 Years.

In the course in freehand drawing, instruction is given in the drawing from models, casts and designs. Work is taken up in charcoal and also in colors. This course has appealed to many young women of the city, and it is believed that this is a most fortunate opportunity for both young women and young men of Lowell to acquire the elements of artistic designing.

CHEMISTRY AND DYEING DEPARTMENT.

Hardly any branch of applied science plays so important a part in our industrial world as chemistry. Many large mills employ the chemist as well as the dyer, and with the great progress which is being made in the manufacture and application of dyestuffs, a basic knowledge of chemistry becomes an absolute necessity to the dyer. Within a comparatively short distance from Lowell are establishments employing men who require some knowledge of chemistry but who may not necessarily use dyes. Some find a knowledge of analytical chemistry helpful in their everyday work.

To meet these varying needs of our industrial community, the school offers a two-year course in general chemistry, organic and inorganic, which may be followed by any one of three courses, viz., textile chemistry and dyeing, analytical chemistry, and textile and analytical chemistry. In order to take Courses 412, 413 or 414, candidates must have a certificate from Course 411, or show by examination or approved credentials that they have taken the equivalent of the work covered by this course.

411. Elementary Chemistry — 2 Years.

General Chemistry, including Inorganic and Organic.

Qualitative Analysis.

One lecture and one Laboratory Period per week in General Chemistry the first year, continued three nights a week during the second year, when the Elementary Organic Chemistry and Qualitative Analysis is completed.

Instruction in Elementary Chemistry extends through two years, and includes lectures, recitations and a large amount of individual laboratory work upon the following subjects: —

Theoretical Chemistry. — Chemical action, chemical combination, combining weights, atomic weights, chemical equations, acids, bases, salts, Avogadro's law, molecular weights, formulæ, valence, periodic law, etc.

Non-metallic Elements. — Study of their occurrence, properties, preparation, chemical compounds, etc.

Metallic Elements. — Study of their occurrence, properties, metallurgy, chemical compounds, etc.

The students take up, as thoroughly as time will permit, the qualitative detection of the more common metals and non-metals, with practical work.

This work, although necessarily elementary, is intended to prepare the student to study more understandingly the manufacture of dyestuffs and coal tar colors in the more advanced courses which follow.

During the first year of the Elementary Chemistry course most of the time is devoted to the non-metals and theoretical chemistry, and the laboratory work covers briefly the non-metals.

During the second year the classroom work is upon metals and the hydrocarbons and their derivatives, and the laboratory work consists entirely of Qualitative Analysis. While this course is necessarily taken up in an abbreviated and elementary manner, it is so arranged that the students may become familiar with the separations and the detections of the common metals and acids. This course is also preliminary to the work given in Analytical Chemistry.

412. Textile Chemistry and Dyeing — 3 Years.

Lectures in Textile Chemistry and Dyeing.

Laboratory Work in Dyeing.

Covered by 40 lectures and two nights of laboratory work per week.

The outline of the lecture course given in Textile Chemistry and Dyeing is as follows: —

Technology of Vegetable Fibers. — Cotton, linen, jute, hemp, china grass. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Animal Fibers. — Wool, mohair, silk. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Artificial Fibers. — Study of the various forms of artificial silk, the process of manufacture, their properties and action with chemicals, acids and heat.

Operations preliminary to Dyeing. — Bleaching of cotton and linen; wool-scouring; bleaching, fulling and felting of wool; carbonizing; silk-scouring and bleaching; action of soap.

The bleaching of cotton is studied with description of the various forms of kiers and machinery used; also the action of the chemicals used upon the material, and the various precautions that must be taken in order to insure successful work.

Under this heading is included a study of the reagents used in the emulsive wool-scouring process, and their action upon the fiber under various conditions; also the most successful of the solvent methods for degreasing wool.

Water and its Application in the Textile Industry. — Impurities present, methods for detection, their effect during the different operations of bleaching, scouring, dyeing, and printing, and the methods used for their removal or correction.

The important subject of boiler waters is also studied under this heading, with a full discussion of the formation of boiler scale, its disastrous results, and the methods by which it may be prevented.

Mordants and Other Chemical Compounds used in Textile Coloring, and classified as Dyestuffs. — Theory of mordants, their chemical properties and application, aluminum mordants, iron mordants, tin mordants, chromium mordants, organic mordants, tannin materials, soluble oil, fixing agents, leveling agents, assistants, and numerous other compounds not dyestuffs that are extensively used in the textile industry.

Under this heading are included the definitions of various terms and classes of compounds used by textile colorists, such as color lakes, pigments, fixing agents, developing agents, mordanting principles and leveling agents.

Natural Organic Coloring Matters. — Properties and application of indigo, logwood, catechu or cutch, Brazil wood, cochineal, fustic, turmeric, madder, quercitron bark, Persian berries, and other natural dyestuffs that have been used in recent years by textile colorists.

Mineral Coloring Matters. — Under this heading are discussed the properties of such inorganic coloring matters and pigments as chrome yellow, orange and green, Prussian blue, manganese brown, iron buff.

Artificial Coloring Matters. — General discussion of their history, nature, source, methods of manufacture, methods of classification and their application to all fibers.

Besides lectures and recitations upon the subject of Textile Chemistry and Dyeing, practical laboratory work is required. By the performance of careful and systematic experiments the student learns the nature of the various dyestuffs and mordants, their coloring properties, their action under various circumstances, and the conditions under which they give the best results. The more representative dyestuffs of each class are applied to cotton, wool and silk, and each student is obliged to enter, in an especially arranged sample book, a specimen of each of his dye trials with full particulars as to the conditions of experiment, percentage of compounds used, time, temperature of dye bath, etc.

For convenience and economy most of the dye trials are made upon small skeins or swatches of the required materials, but from time to time students are required to dye larger quantities in the full-sized dyeing machines.

413. Analytical Chemistry — 3 Years.

Laboratory Work and Lectures in Quantitative Analysis.

Three nights per week of class-room and laboratory work.

The object of this course is to give the student a general idea of the underlying principles of Analytical Chemistry, with a sufficient amount of laboratory work to enable him to become proficient in performing the ordinary routine analysis of the textile plant. Frequent recitations are held for the discussion of methods and the solution of stoichiometrical problems.

The work covered the first two years is based on Smith's "Quantitative Analysis," and for the advanced work, consisting of the analysis of soap, water, oils, cloth and other materials of particular interest to the textile chemist, special lecture notes and Griffin's "Technical Methods of Analysis" is used as a text.

414. Textile and Analytical Chemistry — 4 Years.

Lectures in Textile Chemistry and Dyeing.

Laboratory Work in Analytical Chemistry.

Combines all lectures in Textile Chemistry and Dyeing with work of Course 413, but does not include any Dyeing Laboratory. Three nights per week.

TEXTILE ENGINEERING DEPARTMENT.

This department has arranged to offer those courses of study which lie at the foundation of all engineering. These are designed to give to those engaged in the mechanical, electrical, and manufacturing departments of mills, factories and other industrial establishments an opportunity to learn something concerning the theory underlying the many practical methods which they use in their daily work. Those subjects for which there is usually a regular demand are listed and described below, but similar and allied courses will also be arranged for provided there is a sufficient demand. In the case of all courses there must be an enrollment of at least ten properly qualified students to warrant giving the subject.

613. Mechanical Drawing — 3 Years.

For one having occasion to make a sketch or detail drawing for the purposes of illustration or instruction, or for one who is daily required to work from a drawing or blue print, the course in Mechanical Drawing is offered. It first lays a foundation of the principles of mechanical drawing, and follows this with two years' work in drawing directly from parts of machines, preparing both the detail and the assembly drawing.

This course is a complete course in drawing and requires two evenings per week for three years for its completion. The work is so planned that at its completion a man shall be thoroughly familiar with the making of a working or shop drawing. After a study of the underlying principles of projections and instruction in penciling, inking, lettering and tracing, the subject of sketching and the making of detail drawings therefrom is especially stressed. The preparation of assembly drawings is finally considered.

614. Machine Shop Practice — 2 Years.

This course offers an opportunity to learn the art of metal working and is equally valuable to the man who already has some knowledge of the methods employed as to one who has no knowledge of the same. Thus it becomes possible for one who may be working at the bench during the day to learn how to operate a lathe or other machine tool, or for a lathe hand to acquire a knowledge of a planer, shaper, milling machine, or grinder. A series of lectures is given on the care and management of tools, tool grinding, and the mechanism of the machines. A man who only has a knowledge of the special machine which he operates may by means of this course become a more intelligent machinist. He should supplement this study with the courses in Mechanical Drawing, and in Mechanics and Mechanism, in order that his training for an all-round machinist or mechanic may be more complete. The time required is two evenings per week.

619. Mechanics and Mechanism — 2 Years.

This is one of the most important of engineering subjects dealing as it does with the principles which underlie the transmission of force and motion through

machines and mechanical devices. Its principles are so fundamental and so widely used in more advanced subjects that the student should not consider himself qualified for further work until he has mastered the principles of this subject.

Beginning with a discussion of such important topics as work, power, horsepower, energy and the like, the student then studies the fundamental mechanical principles which are exemplified by the lever, jackscrew, pulley block, inclined plane, wedge, differential pulley and other similar devices. This is followed by consideration of the simpler relations pertaining to uniform and accelerated motion and the course concludes with a study of pulleys, belting, gears and gearing, as far as time permits. No student should undertake this course who is not thoroughly familiar with elementary mathematics. This subject requires attendance two evenings per week with home problem work and the study of a text book.

620. Mathematics — 2 Years.

This course is designed to permit the student to pursue further by evening study the mathematics of his grammar or junior high school course. It includes algebra, elementary trigonometry, logarithms and slide rule, and requires attendance for two evenings per week. It should be taken by all who intend to study further into engineering subjects. Instruction is largely through problem work in class and at home, and the use of a text book.

Some of the topics treated are —

Elementary algebraic operations of —

- Addition.
- Subtraction.
- Multiplication.
- Division.
- Factoring.
- Fractions.

- Graphical representation.
- Linear equations.
- Radicals.
- Logarithms.
- Slide rule.
- Trigonometry.

621. Strength of Materials — 1 Year.

This interesting subject deals with those important principles whereby the person engaged in machine, engine, mill or building design may ascertain whether the parts are strong enough to carry the forces and loads which the nature of the construction imposes upon them.

The fundamental stresses of tension, compression and shear are first considered, together with the ultimate strength of cast iron, wrought iron, steel, and timber. The practical use of this information is illustrated in the design of bolts, tie rods, columns, wall piers, boiler shells, riveted joints, etc. This is followed by a study of the stresses in and design of beams under various conditions of loading, and the course concludes with a discussion of the torsional stresses and twist in shafts. A knowledge of the principles of Mechanics and Mechanism is highly desirable to a satisfactory understanding of this subject. The time required is one evening per week and the method of instruction is through lectures, recitations, problems, and the use of a text book.

622. Steam — 1 Year.

It is the purpose of this course to study the various methods of heat generation, transmission, and utilization in use at the present day and to learn the theoretical relationships which underlie these processes and transformations.

The instruction covers, so far as time permits, the elements of steam engineering. The topics covered are heat and its measurement, use of steam tables, types of boilers, engines and turbines, boiler and engine room accessories, together with a study of the methods of testing the various types of apparatus. Actual tests on such equipment are made as the size of the class permits. Text book, laboratory and class work, and home problems are the methods of instruction used, requiring an attendance of one evening per week.

623. Direct Current Electricity — 2 Years.

This popular course is planned to cover the fundamentals of direct current circuits and machinery. The lectures on electrical theory are supplemented by laboratory work and the use of a text book and problems. It requires for its completion attendance for two evenings per week and a considerable amount of home study and preparation.

The fundamental properties of electrical and magnetic circuits are studied both in the classroom and laboratory. Other topics include the measurement of resistance, the calculation and measurement of power in direct-current circuits, and the relation between the electrical, heat and mechanical units of energy. A large amount of laboratory and class work is given to make the student familiar with methods of operation, testing and control of direct current machinery.

624. Alternating Current Electricity — 2 Years.

This course is similar to Course 623 except that it deals with alternating current circuits and machinery. No student should plan to take this course unless he has previously taken Course 623 or can show that he has had the equivalent. It is also highly desirable that he have a good knowledge of Mathematics as given in Course 620.

The fundamental properties of alternating current circuits are first considered, and is followed by a study of the operation of alternating current machinery. The study of mill illumination and electrical measuring instruments is included in this course. The instruction is given by means of lectures, recitations, and a large amount of laboratory work. An attendance of two evenings per week is required.

FINISHING DEPARTMENT.

In these courses machine work is supplemented by lectures and discussions pertaining to the many finishes given to fabrics. The action of soaps, water, steam, heat and cold upon cloth containing one fiber or combinations of fibers as used in commercial fabrics is carefully studied. These courses also help the finisher to broaden his knowledge of textile fabrics. Attendance is required for two evenings per week.

710. Woolen and Worsted Finishing — 1 Year.

The outline of this course, which is given chiefly by means of lecture work, is as follows: —

Burling and Mending. — Under this head are taken up for consideration the examination of flannel as it comes from the loom; the construction, use and location of the perch; the methods used in marking defects, measuring, weighing and numbering of cloths; also the methods of inspection for fancies, single cloths and double cloths. The object of burling, mending and the types of tables employed, the method of removing knots, runners, etc., the object of back shearing and the use of burling irons, the replacing of missing threads and the importance of sewing as a part of the finishing process, are all considered in detail. The removal of oil and tar spots as well as stains of various kinds is studied.

Fulling. — This branch covers a study of the conditions of the flannel as it comes from the loom, and the influence of oil, etc., upon the procedure. Considerable time is devoted to the various methods of producing a felt, the various types of stocks, and their modifications and development into the present type of rotary fulling mills of both the single and double variety. The details of construction in all machines are carefully taken up and include the design and composition of the main rolls, methods of covering, regulation and means of adjusting the pressure of traps and rolls, and the use and regulation of the various types of stop motion, the different types of stretchers, guide rolls and throat plates.

The theory of felt is taken up and the influence of pressure, moisture, heat, alkali and acid is considered, as well as the hydroscopic and felting properties of different wool fibers. The preparation of the flannel for the mill and the usual methods of determining shrinkages, as well as the various methods of soaping, are given careful attention. The preparation of various fulling soaps and the value of each for the production of various degrees of felt, as well as the determination of the proper amount of alkali for various goods, are carefully studied and demonstrated. The manipulation of the various kinds of goods in the mill, viz., all wool, reworked wools and mixed goods, is studied in classroom and by operation in the laboratory.

The change in weight and strength for each operation is carefully considered, as is also the value of the flocks made in each. A study of the various methods of flocking, such as dry and wet, is considered in both class and machine rooms. In each operation the defects likely to materialize are studied, as well as the cause thereof, and various methods of modifying or lessening them.

Washing and Speck Dyeing. — This branch considers the scouring, rinsing and washing of goods both before and after the fulling process; the various types of washers; and the details of construction, such as suds box, rolls, etc. The theory of scouring, uses of Fullers' earth, salt solutions and sours on the different kinds of goods are made clear by practical work in the machine room, where the effects due to improper scouring, such as stains, cloudy effects, wrinkles and unclean goods, are demonstrated. The discussion of the necessity of speck dyeing follows naturally from the study of these matters, and includes methods of preparation, materials used, application and tests required.

Carbonizing. — This is an important branch of finishing, and includes a study of the various carbonizing agents, methods of application, strength of solutions and neutralizing, as well as the machines used. Stains and imperfections resulting from carbonizing are also considered. The drying and tentering machines and extractors employed are taken up at this point.

Gigging, Napping and Steaming. — The construction in detail of the various types of gigs, nappers, steamers, wet gigs, rolling, stretching, crabbing and singeing machines is discussed, and their actions upon the cloth and the results obtained are explained.

Various methods of obtaining luster and the production of permanent finish are considered in connection with steaming and sponging.

Brushing, Shearing and Pressing. — This includes, as do the other branches, a careful treatment of the machine employed, the preparation of the cloth for each process, the action of each machine in producing its part of the resultant effect. In manipulation of the shear consideration is given to its setting, grinding and adjustment. With the brushing machine the effect of steaming and moisture upon the luster and feel of the goods is shown. A study of the action of the presses, both plate and rotary, involves consideration of pressure, steaming, etc. Special processes to obtain particular effects are taken up, and the part played by each machine is explained. The details involved in handling cloth on a commercial scale, as, for example, measuring, weighing, ticketing, numbering and rolling, are also explained. The necessary calculation and the methods of finishing all grades of goods are considered from time to time during the year.

711. Cotton Finishing — 1 Year.

The outline of the course in the finishing of cotton fabrics is as follows: —

Cloth Room. — Instruction of the various goods and the object thereof; construction of the various types of inspecting and trimming machines.

Shearing. — The object. A consideration of the various types of shears for treating one or both sides at the same time; also the use of the usual cleaning devices, such as emery, sand and card rolls, beaters and brushes; grinding and the adjustment of the various parts.

The use of brushing and cleaning machines, rolling devices and calender attachments for gray goods.

Singeing. — Developing and object of singeing; the construction of singers of all types, and for various purposes; the use of cooling tanks, steaming devices, rolling and brushing attachments.

Regulation of the flame for various goods, and adjustment of the parts; gas and air pressure, water-cooled rolls; the effect of moisture on the cost of singeing; the use of dry cans in connection with singeing; electric singeing.

Washing. — Open width and string washers, their construction and operation; soaps, temperature, squeeze rolls; washing of various goods and the object thereof; stains.

Napping. — The object of napping and the usual method of treating goods; various types of nappers, single and double acting; felting nappers; construction, grinding and adjustment of various types.

Water Mangles. — Their object and the construction of various types; various rolls, — iron, husk, etc.; scutchers, their object and construction.

Starch Mangles. — The object and construction of all types of starch mangles for pure starch and filled goods; various types of rolls, — brass, rubber, wood; action of doctor blades, etc.; regulation and object of pressure.

Methods of starching and finishing all standard goods, also a consideration of the various substances used, such as starch, softener and fillers; the preparation of starch and various methods of application.

Dryers and Stretchers. — Both horizontal and vertical, tenter frames, clips; the swing motion and the finishes thus produced; construction; spraying machines, belt stretchers, button breakers; their object and construction.

Calenders. — The object and construction of all types, including the regulation of pressure and nips for the production of various finishes; various types of rolls and their uses, — steel, husk and paper; the use of hot and cold rolls; chasing, friction, embossing and Schriner calenders and the various finishes produced by each; production of watered effects; beetling machines.

Making up room, — yarding, inspecting; different types of folds; pressing, papering, marking.

EVENING GRADUATES OF 1928

Certificates awarded as follows, April 5, 1928:

Cotton Manufacturing — 4 Years.

Arthur Ernest Fogg . . . . Lowell, Mass.

Woolen Manufacturing — 4 Years.

Carl Leslie Lofgren . . . . Lawrence, Mass.

Woolen Yarns — 2 Years.

Clarence Linwood Salisbury . . . . Lowell, Mass.

Worsted Yarns — 2 Years.

John Hugh Chase . . . . Lawrence, Mass.
Stanley Penney Davis . . . . Lawrence, Mass.
James Venn . . . . Forge Village, Mass.

Cotton Design — 3 Years.

James Kilburn Booth . . . . Nashua, N. H.
James Patrick Fitzgerald . . . . Lowell, Mass.
Daniel Claude Lynch . . . . Lowell, Mass.

Woolen and Worsted Design — 3 Years.

David Eaton Arthur . . . . Methuen, Mass.
Edward Arthur McCarthy . . . . Haverhill, Mass.
Clifford Walton . . . . Lawrence, Mass.

Freehand Drawing — 3 Years.

Mildred Margaret Clevette . . . . Lowell, Mass.
Edith Alice Girard . . . . Lowell, Mass.
Loretta Claire Kiernan . . . . Collinsville, Mass.
Eleanor Grace Lew . . . . Lowell, Mass.
Doris Lavinia Rigby . . . . Lowell, Mass.

Cotton Weaving — 1 Year.

Stephen Augustine Hayes . . . . Lawrence, Mass.
George Henry Rodgers . . . . Nashua, N. H.
Ralph Harland Steele . . . . Hudson, N. H.

Dobby and Jacquard Weaving — 1 Year.

Joseph Paul Beaulieu . . . . Nashua, N. H.
James Kilburn Booth . . . . Nashua, N. H.
Robert Edward Coy . . . . Nashua, N. H.
Edgar Greenwood . . . . Lowell, Mass.
Edward Arthur McCarthy . . . . Haverhill, Mass.
Andrew Francis Rodgers . . . . Nashua, N. H.

Woolen and Worsted Weaving — 2 Years.

George Pickering Edney	Lowell, Mass.
Bertie Holland	Lawrence, Mass.
Robert Matthews	Lowell, Mass.
Albert Wilson	Methuen, Mass.

Cotton Finishing — 1 Year.

Edward Joseph Dunn	Lowell, Mass.
Rufus Holland	Lawrence, Mass.
Robert William Joerger	Lowell, Mass.
Thomas Fletcher Thomson	Lowell, Mass.

Woolen and Worsted Finishing — 1 Year.

Paul Joseph Choquette	Lowell, Mass.
Reginald Williams Glidden	Lowell, Mass.
Frederic William Spedding	Lawrence, Mass.

Elementary Chemistry — 2 Years.

William Austin Ainsworth	Lawrence, Mass.
Luther Anteblian	Lowell, Mass.
William Cameron	Methuen, Mass.
Frank Vincent Flanagan	No. Andover, Mass.
Leo Charles Gagnon	Lawrence, Mass.
Paul Robinson Hammond	Lawrence, Mass.
Joseph Patrick Kenefick	Lowell, Mass.
Nelson McFarlane	Lawrence, Mass.
James Angus McGillivray	Lowell, Mass.
Arthur William Meister	Lawrence, Mass.
Harry William Metcalfe	Lawrence, Mass.
Sam Parry	Methuen, Mass.
Benjamin Franklin Pulsifer	Nashua, N. H.
Randolph Fairfield Ryder	Lowell, Mass.
James Smith	Lowell, Mass.
Emery David Spurr	Lawrence, Mass.
Harold Lee Wheeler	Nashua, N. H.
Leon Weston White	Chester, N. H.
Erwin Wilkinson	Methuen, Mass.

Textile Chemistry and Dyeing — 3 Years.

Edgar Ernest Dubray	Nashua, N. H.

Mechanical Drawing — 3 Years.

Clarence James Blackstock	Lowell, Mass.
Howard Lester MacDonald	Lowell, Mass.
Lester Francis Mulno	Lowell, Mass.
John Baptiste Proulx	Methuen, Mass.
Norman Harold Sanford	Lowell, Mass.
Robert Fraser Sutherland	Lowell, Mass.

Mechanical Engineering — 3 Years.

Everett Claude Sudsbury	Nashua, N. H.

Electrical Engineering — 3 Years.

George Watkins Britton	Nashua, N. H.
Paul Westcott Buxton	Hudson, N. H.
George Alexandre Eno	Lowell, Mass.
Frank Vera Perry	Nashua, N. H.
Manuel Mello Veiga	Lowell, Mass.

Machine Shop Practice — 2 Years.

Joseph Zephirin Marchand	Lowell, Mass.
Ralph Charles Maynard	Nashua, N. H.

Strength of Materials — 1 Year.

Paul Louis Brodeur	Nashua, N. H.
Lloyd Cecil Gordon	Lowell, Mass.
Reginald Hutchinson Macauley	Lowell, Mass.
James Paul McKinley	Lowell, Mass.
Maurice Philippe Phaneuf	Nashua, N. H.

Steam — 1 Year.

Frederick Lovejoy Fisher	Methuen, Mass.
Reginald Joshua Lherault	No. Chelmsford, Mass.

Direct Current Electricity — 2 Years.

Francis Wilber Anderson	Lawrence, Mass.
Roy Edward Blanchard	Graniteville, Mass.
Edgar Roland Born	Lawrence, Mass.
Ernest Lees Chase	Lawrence, Mass.
Joseph Colin Chisholm	Lowell, Mass.
Harry Francis Christie	Lawrence, Mass.
Adolph Cielakie	Lowell, Mass.
Fred Charles Dietrich	Lowell, Mass.
Harry Sidney Forty	Graniteville, Mass.
Raymond Fountain	Lawrence, Mass.
Paul Joseph Hayes	No. Billerica, Mass.
Donald Gardner Hicks	Tewksbury, Mass.
Manuel Paul Jesus	Lowell, Mass.
Thomas William Johnson	Methuen, Mass.
James Alexander Kelly	Lowell, Mass.
Arthur Long	Methuen, Mass.
Louis Edmund Morneau	Lawrence, Mass.
Jack Morton Palmer	Lowell, Mass.
Michael William Schofield	Methuen, Mass.

Alternating Current Electricity — 2 Years.

Howard Lester MacDonald	Lowell, Mass.
Richard Edward Picking	Lowell, Mass.
Oral Erwin Stoddard	Nashua, N. H.
Prentice Church Taylor	Lowell, Mass.

Mathematics — 2 Years.

Lewis Bradford Diman	Lowell, Mass.
Paul Raymond Fitzgerald	Lowell, Mass.
George Russell Hall	Methuen, Mass.
Harold John Herrin	Nashua, N. H.
Joseph Zephirin Marchand	Lowell, Mass.
William Edward Reidy	Lowell, Mass.
Alfred Rotondo	Methuen, Mass.
John Delbert Stewart	Lowell, Mass.
William Stewart	Andover, Mass.
John Joseph Vaughan	Lowell, Mass.
Joseph Francis White	Lowell, Mass.
Arnold Wood	Methuen, Mass.
Chester Wood	Lowell, Mass.

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Effect of Alkalies on Wool: II. Experiments Comparing Effects of Sodium Compounds, Potassium Compounds and Temperature*

By Dr. H. C. Chapin
Lowell Textile Institute

The compounds of potassium have long been preferred to those of sodium for scouring wool. The prevalent opinion of the industry is probably voiced by Knecht, Rawson and Lowenthal in their "Manual of Dyeing," where they say, "Experience shows that other things being equal a soda soap exerts a far more marked injurious action on wool than a potash soap"; further, that "The addition of sodium salts to a potash soap is irrational since a soda soap is thereby formed by double decomposition, and the advantages which it is intended to gain by the use of the more expensive potash soap are thus to a large extent nullified."

The increasing margin in price between potassium and sodium compounds has led to substitution of the latter, both sodium soaps and soda ash, for scouring most wools. To some degree the disadvantages of this substitution have been offset by changes in the fats used for soap making. Can such modification of the sodium soap, or in the manner of using soap and soda ash, give results equivalent to those obtained with potassium soaps and potassium carbonate, or are there qualities inherent in the elements sodium and potassium themselves which forbid this possibility? Favoring the latter contention there is a common belief that because potassium compounds are provided by nature in the wool suint they are therefore the better for wool. The primary object of the research here described was to determine whether there is such a fundamental difference in action between sodium and potassium present as compounds in the wool scouring bath.

In the American Dyestuff Reporter, December 28, 1925, as contribution No. 1 of the Research Committee, American Association of Textile Chemists and Colorists, we presented results of experiments showing that in some cases at least, pH rather than concentration or nature of alkali governs the effect of alkaline solutions on wool. We had used caustic soda and borax solutions at room temperature with the object of simple demonstration of the truth of the principle rather than its practical application. If these results have general significance then the carbonates of sodium and potassium, which in solutions of equimolecular concentration give about the same pH, should in such solutions have about the same effect on wool.

Though at first this hypothesis may appear contradictory to the traditions cited, it is not necessarily so, because mill experience usually combines the effects of many factors, in this case the action of residual soap, alkali, glycerine, etc., in the dried goods, as well as the action of these substances in the bath. Study of each of these factors by itself is well nigh impossible in the mill, where absolute control of every influence is difficult at best, and where successful completion of the product must always take precedence over experiments in process.

While such factors as the influence of glycerine and other soap impurities, or the difference in behavior of sodium and potassium compounds left in the wool after rinsing may well be made objects of future study, it has been the object of the research here described to stabilize or eliminate these other variables, and study only the relative effects of sodium and potassium compounds in the bath at definite temperatures and concentrations.

Experimental

For this purpose we constructed a thermostat in which seven flasks containing wool and solutions could be held at the same temperature, fixed within a small fraction of a degree. Twenty-eight skeins weighing about

*Research Contribution No. 4. Research Committee of the American Association of Textile Chemists and Colorists. Presented before the Northern New England Section, January 22, 1927.

3.2 grams each were prepared from one ball of naphtha extracted yarn similar to that used in our earlier investigation. As before, each skein was assembled from five smaller skeins taken from different parts of the ball. After assembling all were rinsed uniformly with petroleum ether, followed by water. The twenty-eight were then divided into four groups of seven each, which we may designate 11 to 17, 21 to 27, 31 to 37, and 41 to 47. The first digit in each will then be the number of the group.

The same numbers will be used for the solutions in which these skeins were to be soaked. The solutions of group 1 were identical in composition with the corresponding members of group 2. The first in each case was distilled water, the second was 1/10 normal sodium carbonate, the third 2/10 normal sodium carbonate, the fourth 4/10 normal sodium carbonate, the fifth 1/10 normal potassium carbonate, the sixth 2/10 normal potassium carbonate, and the seventh 4/10 normal potassium carbonate. The members of groups 3 and 4 each contained ½ of 1 per cent of pure sodium olive oil soap. In other respects they were identical with the corresponding members of groups 1 and 2.

Of each solution 50 c.c. were used for rinsing the skein just before soaking and 450 c.c. for the soaking. Groups 1 and 3 were soaked at 47 degrees Cent., equivalent to 116.6 degrees Fahr., and groups 2 and 4 at 53 degrees Cent., equivalent to 127.4 degrees Fahr. In other respects the manner of soaking was as nearly as possible identical for all four groups.

The seven stoppered flasks bearing the solutions of a group were immersed nearly to their tops in the water of the thermostat and brought to temperature. The skeins were then rinsed and immersed in their respective solutions. Soaking was continued for three hours, during which period at three different times each skein was stirred about slightly in its solution. At the end of the soaking period the skeins were removed, rinsed for an hour in running water and dried at room temperature. To avoid variations in soaking time the order in which the skeins were removed was made the same as the order of immersion.

The next step was to compare effects of solutions and temperatures upon the wool. Of course the first practical evidence of damage is the surface harshness which becomes objectionable to an experienced observer long before weakening is evident. For this harshness there is unfortunately no definite method of measurement, but through the prolonged three-hour soaking period we hoped to produce weakening effects, under various conditions, which would follow the same order in magnitude as the harshening effects of the same series of conditions in the shorter time interval of practical scouring.

It was possible later to check the accuracy of this method by noting the previously well-known effects of alkali concentration and temperature in the same set of strength measurements which we used to prove the comparative action of sodium and potassium compounds. Finding known influences truthfully represented we could depend on finding the sought-for differences in action between sodium and potassium compounds, if such differences exist.

As shown in our earlier paper the harshness which accompanies weakness tends to hinder slipping of one fiber upon another in yarn under test, thus partially compensating for fiber weakness. This opposing effect we found could be avoided to some extent by wetting each strand just before test; which practice we employed throughout the present work, with the added advantage of avoiding changes in wool condition through fluctuations in atmospheric humidity. As before, specimens were mounted between grips 50 centimeters apart under initial tension of 50 grams, and pulled at the rate of 1 foot per minute.

Results

In Tables I and II each number under the heading of strength represents an average of seventy or more tests upon one of the composite skeins, in reality five skeins treated in one solution. The effect of temperature is plainly evident. Comparing corresponding members of groups 1 and 2 and of groups 3 and 4, we find the 53 degree member to be the weaker in all fourteen comparisons except the first, which is between skeins treated with water alone.

The effect of concentration is equally clear though smaller. In each group we may compare the action of 2/10 normal carbonate with that of 1/10 normal, and that of 4/10 normal with that of 2/10 normal. Sixteen comparisons are possible, and in all but one the effect of higher concentration is apparent in lower strength.

No.	Bath	Strength after Soaking at 47°	53° C.	Ph. before	after
11	water	177 grams			
12	.1 N. Na_2CO_3	150		11.01	10.89
13	.2 N.	143		11.13	11.02
14	.4 N.	143		11.21	11.10
15	.1 N. K_2CO_3	157		10.99	10.86
16	.2 N.	143		11.07	10.99
17	.4 N.	136		11.15	11.06
21	water		177		
22	.1 N. Na_2CO_3		145	11.01	10.85
23	.2 N.		132	11.13	10.98
24	.4 N.		125	11.21	11.05
25	.1 N. K_2CO_3		145	10.99	10.84
26	.2 N.		133	11.07	10.95
27	.4 N.		125	11.15	11.01

TABLE I

No.	Bath 5% soap in	Strength after soaking at 47°	53° C.	Ph after
31	water	170 grams		
32	.1 N. Na_2CO_3	164		
33	.2 N.	154		
34	.4 N.	146		
35	.1 N. K_2CO_3	156		
36	.2 N.	151		
37	.4 N.	148		
41	water		167	
42	.1 N. Na_2CO_3		146	10.76
43	.2 N.		141	10.87
44	.4 N.		124	10.89
45	.1 N. K_2CO_3		149	10.82
46	.2 N.		142	10.87
47	.4 N.		136	10.88

TABLE II

The consistency of these figures with one another and with the known facts is remarkable in view of the small effects shown. The average loss for 6 degrees Cent. rise in temperature is 12 grams, and for each doubling of carbonate concentration but 8 grams. The strength of the original yarn soaked in cold water alone was 194 grams, so that these differences of 12 and 8 grams amount to but 6 per cent and 4 per cent respectively. With the two exceptions mentioned, the smallest of the individual differences upon which we have based our averages are 5 grams temperature effect and 3 grams concentration effect, so that the figures would have been equally consistent for a temperature interval of less than 2 degrees Cent., or effect on strength of less than 2 per cent. The effect of carbonate concentration is strikingly small in comparison with that of temperature, 25 per cent increase in concentration being equivalent to 1 degree Cent. rise in temperature.

We may now proceed to a comparison of the two carbonates with assurance of finding evidence of difference in their action if there be any practical difference. In group 1, skein number 13 is equal in strength to number 16. The other two pairs of figures show the sodium carbonate skein to be the stronger in one case, the potassium carbonate skein just as much the stronger

in the other. In group 2 there is virtual agreement between partners. The average effect of sodium carbonate is therefore identical with that of potassium carbonate in each group.

In the other two groups, treated with sodium soap as well as carbonates, we find four cases of agreement within 3 grams. In group 3 one other comparison shows greater effect from potassium carbonate and in group 4 one shows greater from sodium carbonate, so the average of group 3 favors potassium carbonate and that of group 4, sodium carbonate. Altogether, groups 3 and 4, as well as groups 1 and 2, reveal virtually no difference in action between the two carbonates.

What then is the effect of soap? The original strength of the yarn was measured by 280 tests on three composite skeins, extracted like the others with petroleum ether but soaked in water alone at room temperature. These averaged 194 grams. Water at 47 and 53 degrees reduced the strength as shown in the first table to 177 grams, ½ per cent soap as shown in the second table to 168.5 grams, and 1/10 normal carbonates as shown in average of tests 12, 15, 22 and 25 to 149 grams. By subtraction we find the effect of heating the water to 50 degrees to be 17 grams, that of ½ per cent soap 8.5 grams, and that of carbonate in 1/10 normal solution (about ½ per cent in case of sodium), 28 grams.

To be sure these figures do not carry quite the same weight as the averages previously quoted, because they are based on smaller numbers of skeins and tests, but even after allowance for possible error they show the effect of sodium soap to be distinctly less than that of hot water or alkali carbonate. If potassium soap has any effect whatsoever, it cannot be far less than that of this sodium soap. So far as injurious action within the bath itself at a given temperature is concerned, we must therefore consider the two soaps practically equivalent, like the carbonates.

If there be differences they are in ease of rinsing, in subsequent action upon dried or drying wool, or in the temperature which may be employed for scouring or rinsing. It is well known that the potassium soaps and carbonates are the more hygroscopic, and that potassium soaps are more likely to contain glycerine, also hygroscopic, as an impurity. It is probable that considerable amounts of these substances are carried from the scouring train by wool, with consequent effect upon its condition for spinning. If this be true it may be more economical to add small amounts of potassium soap or glycerine to the last or next to the last bowl, rather than to use potassium compounds exclusively in scouring.

Comparing sodium and potassium soaps made from the same fat we can see probable advantage for the potassium soap in the lower temperatures at which it will scour and at which it will rinse out; but this advantage may be gained through substitution of some other fat in soap manufacture as well as through substitution of potassium for sodium. There is also the possibility of rinsing more thoroughly by addition of such assistants as ammonia, which is sometimes used at the end of fulling and rinsing operations in finishing. These of course are but suggestions which require further study.

Contrasted with the mildly injurious action of soap by itself we find protective action from the same soap against the weakening effects of alkali carbonates. The average strength of the carbonate treated skeins of groups 3 and 4 is 7 grams greater than that of the corresponding skeins of groups 1 and 2, which had the same treatment except for the omission of soap.

The pH measurements were made electrically at room temperature of about 75 degrees Fahr. Hydrogen was supplied to the electrode directly from a tank of the compressed gas. This arrangement, with the same tank of gas, had given results on standard buffer solutions which agreed with accepted values within less than 1/10 of a unit.

Though recorded to the second decimal place, where there is some justification for comparisons, the figures in the tables are not presumably accurate in absolute value beyond the first decimal place. The carbonate solutions were prepared from ordinary analytical chemicals and boiled distilled water, and were adjusted to the desired concentrations on basis of titrations against the

same standard acid. Their pH values are probably low compared with those from the best authorities in the literature, but they are as representative of ordinary scouring solutions as would be measurements on more carefully purified water and chemicals.

SUMMARY

Average strength of skeins soaked in	
water at room temperature	194.
water, average of 47° and 53° C	177.
soap solutions average of 47° and 53°C	169.
carbonate solutions at 47°	145.
carbonate solutions at 53°	134.
carbonate and soap solutions at 47°	153.5
carbonate and soap solutions at 53°	139.5
carbonate .1 N., with and without soap	151.
carbonate .2 N., with and without soap	142.
carbonate .4 N., with and without soap	135.
solutions of Na_2CO_3 alone	139.5
solutions of K_2CO_3 alone	139.5
solutions of Na_2CO_3 and soap	146.
solutions of K_2CO_3 and soap	147.

TABLE III

The pH values in the tables are notable chiefly for lack of pronounced differences. In our earlier work doubling of caustic soda concentration caused a rise of more than .3 in pH and consequent drop of 19 grams in wool strength. Here doubling carbonate concentration raises pH but 1/10 of a unit, so it is not surprising that the consequent drop in wool strength averages but 8 grams for each doubling of carbonate concentration.

In our earlier work the drop in pH through neutralization of caustic soda by wool averaged .4. Here the effect of wool on carbonate averages but .11 of a pH unit at 47 degrees and .14 at 53 degrees. The .03 greater drop at 53 degrees is plausible in view of the conversely greater effect of solution on wool at the higher temperature, but the difference in pH is unfortunately too small to be considered safely above the possible errors of measurement.

The slight buffer action of soap is evident in the .1 lower average of the few pH measurements on soap solutions, compared with the average for the corresponding unsoaped solutions. The soap used was the best obtainable castile prepared for medicinal purposes. Like many textile soaps it doubtless contained excess fatty acid to prevent possibility of excess alkali. This would account for its buffer action, lowering the pH and injurious effect of carbonates. Excess of fatty acid would not necessarily prevent entirely the hydrolysis of soap to form traces of free alkali in water solution, hence the mildly injurious effect of soap by itself.

Similar behavior was shown in our earlier work by borax. Added to caustic soda solutions it reduced their injurious effects in proportion to reduction in pH, but alone, as we have found in a recent experiment, it has a slight injurious effect of its own. Possible buffer action of the soluble impurities of raw wool might be studied to advantage.

CONCLUSIONS

1. The strength of wool has been measured before and after treatment with water, alkali carbonate solutions and soap solutions, in vicinity of 50 degrees Cent. or 122 degrees Fahr. In the results the effects of small changes in treatment are so apparent as to justify use of weakening effect as a measure of surface harshening effect provided only that there is some direct connection between the two.

2. In solutions of equal molecular concentration sodium carbonate and potassium carbonate have equal weakening effect.

3. The effect of sodium soap is small compared with that of the hot water in which it is dissolved, and much smaller than that of tenth normal sodium

carbonate or potassium carbonate solution. If there be any difference in effect of sodium and potassium soaps it must therefore be trifling in comparison with other influences commonly present in the bath.

4. A soap which in water alone weakens wool may in solution with alkali carbonate reduce the weakening effect of the carbonate.

5. A rise of 1 degree Cent., or 2 degrees Fahr., in scouring temperature has about the same weakening effect on wool as a rise of 25 per cent in carbonate concentration, when the temperature is near 50 degrees Cent., and carbonate concentration near 2/10 normal.

6. For control of scouring bath alkalinity with delicacy equivalent to that of observation of effects on wool it would be necessary to measure pH with considerable care, to within a few hundredths of a unit; though rougher measurements might serve to indicate wide departure from desired conditions.

These conclusions apply only to action within the bath itself, not in the dried or drying wool.

The conclusion that sodium compounds can be substituted for potassium compounds without injury to wool has since been confirmed by a series of full scale manufacturing experiments covering scouring, spinning and intermediate operations in a mill near Lowell. This promises not only an immediate financial saving to the industry, but also independence from foreign potash monopoly.

Southwick Hall

SERIES 32, No. 3 *February, 1929*

Bulletin

of the

Lowell Textile Institute

LOWELL, MASS.

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1929

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Moody Street and Colonial Avenue

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CALENDAR

1928–1929

September 13–14, Thursday–Friday . . .	Entrance Examinations
September 17–22, Monday–Saturday . .	Re-examinations
September 19, Wednesday, 9.00 A.M. . . .	Registration for Freshmen
September 24, Monday	Registration for upper-class students Classes begin for Freshmen
September 25, Tuesday	Classes begin for upper-class students
October 12, Friday	Columbus Day — Holiday
November 27, Tuesday, 4.45 P.M.	Thanksgiving recess begins
December 3, Monday, 9.00 A.M.	Thanksgiving recess ends
December 21, Friday, 4.45 P.M.	Christmas recess begins
January 7, Monday, 9.00 A.M..	Christmas recess ends
January 21, Monday	First term examinations begin
February 1, Friday	End of first term
February 4, Monday	Second term begins
February 22, Friday	Washington's Birthday — Holiday
April 17, Wednesday, 4.45 P.M.	Spring recess begins
April 22, Monday, 9.00 A.M.	Spring recess ends
May 20, Monday	Second term examinations begin
May 30, Thursday	Memorial Day — Holiday
June 4, Tuesday	Commencement
June 6–7, Thursday–Friday	Entrance Examinations

1929–1930

September 19–20, Thursday–Friday . . .	Entrance Examinations
September 23–28, Monday–Saturday . .	Re-examinations
September 26, Thursday, 9.00 A.M. . . .	Registration for Freshmen
September 30, Monday	Registration for upper classmen Classes begin for Freshmen
October 1, Tuesday	Classes begin for upper classmen
November 26, Tuesday, 4.45 P.M.	Thanksgiving recess begins
December 2, Monday, 9.00 A.M.	Thanksgiving recess ends
December 20, Friday, 4.45 P.M.	Christmas recess begins
January 6, Monday, 9.00 A.M..	Christmas recess ends
January 27, Monday	First term examinations begin
February 7, Friday	End of first term
February 10, Monday	Second term begins
April 16, Wednesday, 4.45 P.M.	Spring recess begins
April 21, Monday, 9.00 A.M.	Spring recess ends
May 26, Monday	Second term examinations begin
May 30, Friday	Memorial Day — Holiday
June 10, Tuesday	Commencement
June 12–13, Thursday–Friday	Entrance Examinations

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HISTORICAL SKETCH
of the
LOWELL TEXTILE INSTITUTE

By virtue of legislative acts of 1928, the Lowell Textile School became known as the Lowell Textile Institute in order to more clearly define the standing of the institution. This was the natural result of the development of the original ideas and policies of the trustees who founded the Lowell Textile School. The articles of incorporation were authorized by Chapter 475, Acts of 1895, and provided for a corporation to be known as the Trustees of the Lowell Textile School of Lowell, Massachusetts. The movement for the establishment of the school dates from June 1, 1891, but it was not opened for instruction until February 1, 1897.

In accordance with the acts of incorporation the Board of Trustees consisted of twenty permanent and self-perpetuating members, three-fourths of whom must be "actively engaged in, or connected with, textile or kindred manufactures." In addition, His Honor the Lieutenant-Governor, the Commissioner of Education of the State, the mayor, the president of the municipal council, the superintendent of schools of Lowell, and a representative of the textile council were members *ex-officio.* Legislative acts of 1905 and 1906 authorized the graduates of the school to elect four trustees serving for periods of four years each.

By virtue of the anti-aid amendment to the State Constitution, and by Chapter 274, General Acts of 1918, the property of the school was transferred on July 1, 1918, to the Commonwealth of Massachusetts, and the control and management of the school was vested in a Board of Trustees appointed by the Governor, "with all the powers, rights and privileges and subject to all the duties" of the original Board.

In locating the Institute at Lowell, which has been called the "Mother Textile City of America," considerable advantage is secured by close association with every branch of the industry, which utilizes almost every commercial fiber in the products of the great Merrimack Valley textile district.

Although the school was formally opened by Governor Roger Wolcott on January 30, 1897, in rented quarters in the heart of the city, it was not until January, 1903, that the first buildings of the present plant were ready for occupancy. On February 12, 1903, Governor John L. Bates dedicated the present buildings.

PURPOSE AND SCOPE OF THE INSTITUTE

The object of the establishment of the Institute as set forth in the original act was "for the purpose of instruction in the theory and practical art of textile and kindred branches of industry."

The plan was occasioned by the apparent crisis in the leading industry of New England, due to the rapid development of the manufacture of the coarser cotton fabrics in the southern States. It was believed that this crisis could be met only by a wider and more thorough application of the sciences and arts in the production of finer and more varied fabrics.

Following the general methods and systems found successful at the higher polytechnic institutes, it offers thorough instruction in principles of the sciences and arts applicable to textile and kindred branches of industry. The courses treat not only of the theory but also the application of these principles in the processes, on the machines and throughout all departments of industry involved in the successful manufacture, application and distribution of textile material in any form.

Though from the first the management has kept in view the clearly defined objective which called for the establishment of the Institute, it has developed its curriculum, its methods of instruction, and equipment as the needs of the industry arose. This objective will be kept constantly in view, and as new demands are presented an effort will be made to extend courses, equipment and floor space. The mechanical equipment of the Institute includes the best makes of textile machinery, and these machines, while built as they would be for regular work, are, as far as possible, adapted to the experimental work which is of particular value in such an institution as this.

Because of the breadth, grade and character of instruction given, and because of the standing and personnel of the instructing staff, the Institute has been placed by both Federal and State educational boards in the class of the higher technological schools of this country.

The United States Civil Service Commission recognizes graduates from the degree courses of this school as proper applicants for the examination to the various positions requiring a knowledge of applied science and engineering, as well as a knowledge of textile manufacturing, in the different departments of the government.

The day classes have been organized for those who can devote their entire time for three or more years to the instruction requisite in preparing to enter the textile industries. It has been found necessary to require of all such students educational qualifications equivalent to those given by a regular four-year course of a high school or academy of good standing.

The evening classes are held for about twenty weeks of the year, and are for those who are unable to attend the day courses. These are similar to the day courses, but are aimed especially to meet the needs of students working during the day in the mills and shops. For entrance to these classes an applicant should have the equivalent of a grammar school education. A detailed description of these courses and requirements is given in another Bulletin, which will be sent upon request.

BUILDINGS AND GROUNDS

The site is a commanding one, consisting of about 15 acres at a high elevation on the west bank of the Merrimack River. It extends to and overlooks the rapids of Pawtucket Falls, which was the first water power in America to be used on an extensive scale to operate power looms. It was contributed by Frederick Fanning Ayer, Esq., of New York City, and the Proprietors of the Locks and Canals on the Merrimack River.

Southwick Hall, the main building, fronting on Moody Street, was contributed by the Commonwealth of Massachusetts and Frederick Fanning Ayer, Esq., and is a memorial to Royal Southwick, a leading textile manufacturer, a public man of earlier days, and a maternal ancestor of Mr. Ayer. It includes a central mass 90 by 90 feet, having three stories and two wings 80 by 85 feet each with two stories and well-lighted basements. The building is pierced in the center by an arched way from which access is had to the wings and to the central courtyard. The northern wing is occupied by the General Offices, Engineering and Finishing Departments, and Library, while the southern wing is entirely occupied by the Chemistry and Dyeing Departments.

Kitson Hall, dedicated to the memory of Richard Kitson, was contributed by Charlotte P. Kitson and Emma K. Scott, his daughters; the Kitson Machine Company of Lowell, founded by Mr. Kitson, was also a generous contributor. This hall makes a right angle with Southwick Hall, is 70 by 183 feet, and has two stories and a basement. The first floor is occupied by the Cotton Yarn and Knitting Departments, while the basement contains the Mechanical and Electrical Engineering laboratories and the Machine Shop.

The Falmouth Street Building forms the third side of the quadrangle, and consists of three portions, one 60 by 75 feet, three stories, one 75 by 130 feet, three stories, and the head house 70 by 80 feet, three stories and basement. The building is occupied by the picker section of the Cotton Yarn Department, the Design and Power Weaving Department and by the Woolen and Worsted Yarn Department, and contains on the lower floors an equipment for the manufacture of wool yarn from the fleece to the finished yarn. The upper floors are occupied by a great variety of plain, dobby and Jacquard looms, and in a section of the building are the students' lockers and recreation rooms.

Colonial Avenue Building was erected in the summer of 1910 from plans prepared by the Engineering Department, which also had in charge the work of construction. The building completes the fourth side of the quadrangle, and in outward appearance corresponds to the architectural features of the other school buildings. It is a single-story building, and has the dimensions of 195 by 60 feet. Its interior is faced with cement brick made at the school during the progress of the

work. These serve to give light-reflecting walls which are advantageous for the work of the Wool Manufacturing, Cotton Finishing and Chemistry and Dyeing Departments that occupy this building. The funds for this building were provided by the State of Massachusetts.

The buildings are of modern mill construction adapted to educational uses and contain approximately 180,563 square feet.

CAMPUS

Through the generosity of Mr. Frederick Fanning Ayer the Institute has been provided with a campus and athletic field of about 3 acres. This has been carefully graded and laid out for baseball, football and track athletics.

To enclose this field the Alumni Class Fence has been partly built. It is made of forged iron sections supported between brick columns. Each section is contributed by a class, so that in the course of a few years this fence will entirely enclose the field.

On the upper floor of the Falmouth Street Building there has been provided a recreation room for the use of the students at such times as their attendance is not required in classes.

In the basement of this building there are rooms for the use of the athletic teams. Connected to these are showers and dressing rooms.

The upper hall of Southwick Hall has been equipped with gymnastic apparatus. Chest weights, wooden dumb-bells, Indian clubs, a set of traveling rings, a vaulting horse, parallel bars, a punching bag and several sets of foils and single sticks have been provided.

In order to be sure that no student having any dangerous physical weakness takes part in any athletic contest, all candidates for the various athletic teams are obliged to pass a satisfactory physical examination.

ENTRANCE REQUIREMENTS

Particular stress should be laid upon a thorough grounding in mathematics, including algebra, arithmetic and plane geometry, as these form the basis upon which the work of this school rests. While solid geometry is not required at the present time, the student will find a knowledge of this subject very valuable in his subsequent work, and is strongly recommended to include this subject as one of his electives. A preliminary course in science, including physics and chemistry, serves to prepare the student's mind for the higher branches of these subjects and their application, but neither will be considered as the equivalent of the courses in these branches given in the Institute.

Degree Courses

Candidates for admission to either of the degree courses must be graduates of a school approved by the New England College Entrance Certificate Board or by the Board of Regents of New York, and must present a certificate from the principal of the school last attended, reporting upon the subjects pursued and the points obtained according to the schedule of studies given hereafter. A total of fourteen points is required.

A point represents satisfactory work in a year's study in a specified subject in an approved secondary school.

Required Subjects	Points
Algebra A1	1
Algebra A2	1
English	4
Elementary French A (two years) or Elementary German A (two years)	2
Plane Geometry	1
History (American, Medieval and Modern, or English)	1
Physics	1
	11

Elective Subjects	Points
Chemistry	1
Elementary French (two years) or Elementary German (two years)	2
Advanced French or German (one year in addition to requirements of Elementary French A or Elementary German A)	1
History:	
American	1
Medieval and Modern	1
English	1
Latin	1
Mechanical Drawing	1
Mechanic Arts	1
Solid Geometry	1
Spanish	1
Trigonometry	1

An applicant may also be admitted on the basis of entrance examinations, in which case he must pass a sufficient number of the required subjects to make ten points and present certificates showing satisfactory courses in such of the elective subjects to make three additional points.

The objective of the elective requirements is to encourage greater breadth of preparation than that covered by the required branches. Certificates covering other subjects than those listed as elective will be entertained.

Diploma Courses

Candidates for admission to the diploma courses are accepted upon presentation of properly vouched certificates showing the completion of a regular four-year course in a high school or academy of reputable standing. The certificate must specify that the applicant has satisfactorily passed the required subjects.

A total of twelve points is required.

Required Subjects	Points
Algebra A1	1
Algebra A2	1
English	4
Plane Geometry	1
History (American, Medieval and Modern, or English)	1
Physics	1
	9

Elective Subjects

Three may be selected from the list under Degree Courses.

ENTRANCE EXAMINATIONS

All students who are unable to present a certificate for either the degree or the diploma courses must pass entrance examinations. Notification of intention to take these examinations must be made in writing at least a week before the date of the examinations. These will be held as follows: —

Thursday, June 6, 1929; Thursday, September 19, 1929; Thursday, June 12, 1930: —
Algebra, 9 A.M. to 11 P.M.
History, 11 A.M. to 1 P.M.
English, 2 P.M. to 4 P.M.

Friday, June 7, 1929; Friday, September 20, 1929; Friday, June 13, 1930: —
Plane Geometry, 9 A.M. to 11 A.M.
German or French, 11 A.M. to 1 P.M.
Physics, 2 P.M. to 4 P.M.

Candidates failing to pass the June examinations are allowed to try again in September; those who cannot attend the June examinations may present themselves in September.

REQUIRED SUBJECTS FOR ENTRANCE

Algebra A1. — Derivation and use of simple formulas, graphical representation, the meaning and use of negative numbers, linear equations, with one or two unknown quantities, ratio and proportion, the essentials of algebraic technique, simple cases of exponents and radicals.

Algebra A2. — Numerical and literal quadratic equations in one unknown quantity, the binomial theorem for positive integral exponents, arithmetic and geometric series, simultaneous linear equations in three unknown quantities, simultaneous equations consisting of one quadratic and including graphical solutions, exponents and radicals.

Plane Geometry. — The usual theorems and constructions of good textbooks, including the general properties of plane rectilinear figures, the circle and the measurement of angles, similar polygons, areas, regular polygons, and the measurement of the circle. The solution of original problems and problems in mensuration of lines and plane surfaces.

English. — As secondary schools are following to a greater extent than heretofore the requirements of the College Entrance Examination Board, it is recommended that the applicant to this school conform to the suggestions of this Board relative to English composition and literature.

The examination consists of two parts, both of which are given at the same time.

(*a*) With the object of testing the student's ability to express his thoughts in writing clearly and correctly he will be required to write upon subjects familiar to him. Emphasis will be laid upon the composition, punctuation, grammar, idiom and formation of paragraphs. He will be judged by how well he writes rather than by how much he writes.

(*b*) The second part of the examination is prepared with the view of ascertaining the extent of the student's knowledge of good literature, and to test this examination questions will be based on the books adopted by the National Conference on Uniform Entrance Requirements. Any course of equivalent amount if made up of standard works will be accepted.

History. — Applicants may offer a preparation of American history, English history, or medieval and modern history.

In American history applicants should be familiar with the early settlements in America, the colonies, their government, the customs of the people, and events which led to the establishment of the United States. They should be informed concerning the causes and effects of the principal wars in which the country has been involved. They should be prepared to consider also questions requiring an elementary knowledge of civil government, as well as historical facts connected with the growth of this country up to the present time.

For the subject of English history or medieval and modern history the course given in any reputable secondary school should give proper preparation. A course extending over a full year with not less than three periods a week will be accepted.

Physics. — The applicant should be familiar with the fundamental principles of physics, particularly those considered under the headings of mechanics, heat, light, electricity and magnetism. Textbook instruction should be supplemented by lecture table experiments. Wherever possible, the student should pursue a laboratory course, but for the present no applicant will be conditioned in this subject if he has not been able to carry on a laboratory course. Where a laboratory course is offered by a secondary school, it should cover at least twenty-five of those experiments listed in the syllabus of the College Entrance Examination Board.

Modern Languages. — Required for degree courses only. It is expected that the work in these subjects has covered a period of at least two years of preparatory school training or the equivalent. Importance should be given to the ability to translate into good idiomatic English, but attention should also be paid to grammar and construction, that greater care may be used in translation.

Elementary German A. — The entrance examination is composed of two parts, both taken, however, at the same time.

(*a*) Translation of simple German prose into good idiomatic English.

(*b*) Questions to test proficiency in grammar, and simple English sentences to be rendered into German.

The requirements include the declension of articles, adjectives, pronouns and nouns; the conjugation and inflection of weak and strong verbs; the simpler uses of the subjunctive; the use of the modal auxiliaries; the prepositions and their uses; the principal parts of important verbs; and the elementary rules of syntax and word order.

Texts used in the language courses of any reputable high or preparatory school will furnish reading for translation. A list of texts is offered by the College Entrance Examination Board.

Elementary French A. — The entrance examination is composed of two parts, both taken, however, at the same time.

(*a*) Translation of simple French prose into good idiomatic English.

(*b*) Questions to test proficiency in grammar, and simple English sentences to be rendered into French.

The requirements include the principal parts, conjugation and inflection of the regular and the more common irregular verbs; the singular and plural forms of nouns and adjectives; the uses of articles and partitive construction; the forms and positions of personal pronouns; and the simpler uses of the conditional and subjunctive.

Suitable texts are suggested by the language courses of any reputable high or preparatory school and by the requirements of the College Entrance Examination Board.

Students who have pursued two years of elementary French as well as two years of elementary German may present one subject to cover two points in the required subjects, and the other to cover two points in the elective subjects.

ELECTIVE SUBJECTS

History. — If the applicant can present all three or any two branches of history specified he may include one as a required subject and the others in the list of elective subjects.

Chemistry. — Applicants must show evidence of their familiarity with the rudiments of chemistry. Any course given in a secondary school organized to present instruction by means of textbook or lecture, together with correlated laboratory work, will be considered as covering the requirements. The applicant's notebook with his original notes, including description of experiment, apparatus used, reactions, observations and deductions, must be accompanied by his instructor's certificate.

Importance will be placed upon manipulation and deductions as well as the general appearance and neatness of the notebook.

Solid Geometry. — The usual theorems and constructions of good textbooks, including the relations of planes and lines in space, the properties and measurement of prisms, pyramids, cylinders and cones; the sphere and spherical triangles. The solution of original problems and the applications of the mensuration of surfaces and solids.

Trigonometry. — The usual courses of instruction covered by the standard textbooks on plane and spherical trigonometry will prepare an applicant sufficiently to meet this requirement.

Mechanical Drawing. — The applicant must have pursued such a course in mechanical drawing that he will be familiar with the usual geometrical construction problems, projection of points, lines, planes and simple solids.

Importance is laid not only upon the accuracy with which the work is performed, but upon the general arrangement, appearance and care with which the plates are executed.

It should not be understood that work in this subject may be offered as the equivalent of the first term's work at the Institute.

Mechanics Arts. — The usual courses offered by properly equipped preparatory schools will be accepted as suitable fulfillment of this requirement. Work should include instruction in the handling of both wood and metal working tools in the more simple practices of these arts.

Elementary French B. — Applicants who enter for one of the three-year courses may present one year's work in French in a secondary school. Those who present themselves for examination in this subject should be familiar with the rudiments of grammar, and be able to translate simple French prose into good idiomatic English, also to translate into French English sentences, based on the French given for translation.

Elementary German B. — Applicants who enter for one of the three-year courses may present one year's work in German in a secondary school. What is stated in regard to French applies to those who may present German instead of French.

Advanced French or German. — In cases where applicants have pursued courses in French or German for more than two years, and have completed work which is more advanced than is included under elementary French or German, they may offer the additional year as an elective.

Spanish. — Students offering Spanish should be familiar with elementary grammar, the common irregular verbs, and be able to translate simple Spanish to English or English to Spanish. A preparation equivalent to three periods per week for two years will be acceptable.

Latin. — Students who have pursued one or more years of Latin may present this subject as an elective. Each year's work satisfactorily completed will be considered equal to one point.

ADVANCED STANDING

Candidates who may have received previous training in any of the subjects scheduled in the regular course will, upon presentation of acceptable certificates, be given credit for such work.

GRADUATE COURSES

Graduates of technical courses of other schools are invited to communicate with the president with reference to special courses in the textile studies. Previous

training in the sciences and the engineering branches will usually reduce materially the time necessary to complete any of the courses at the Institute. The advantages offered to such persons for special research work are unexcelled, and a most profitable course may be arranged.

COURSES OF INSTRUCTION

Degree Courses. — The four-year degree courses are as follows:

Textile Engineering.
Chemistry and Textile Coloring.

At the completion of these courses the degrees of Bachelor of Textile Engineering (B. T. E.) and Bachelor of Textile Chemistry (B. T. C.) are conferred.

Three options are offered in the Engineering Course, viz., general textile, cotton manufacturing or wool manufacturing. Each of these courses is planned to train one in the fundamental principles of science found to be applicable in the particular fields of textile chemistry and textile engineering. It is maintained that for one to be successful in either of these important branches of industry a training is required as thorough and broad as that of any of the recognized branches of engineering or of applied science.

With this in mind these courses have been built of a secure framework of science and mathematics, and to it has been added the useful application of these branches in the broad textile field. With the direct purpose of laying a secure foundation in the training, a more extended preparatory course is first demanded, and subsequently in the school work more subjects of a general character are included, that narrowness of judgment and observation may not result by overstimulation of the technical development.

Diploma Courses. — The following courses extend over a period of three years and upon the completion of any one of these the diploma of the Institute is awarded:

Cotton Manufacture.
Wool Manufacture.
Textile Design.

COURSES FOR WOMEN

Although all classes are open to women, the courses which have appealed especially to their tastes have been textile designing and decorative art. Some have pursued courses in chemistry, and have added to their work in design some instruction in power weaving and finishing. These special courses have in general been followed for three years, and in some cases have led the students to positions either in the mill office or in some commercial lines that have been desirable and have offered congenial work.

Within the last few years the possibilities for women in certain branches of textile chemistry have become recognized, and it is believed that in the future the positions open to them will become more and more numerous.

GENERAL INFORMATION

Application for Admission. — A blank form of application for admission may be found at the end of this bulletin. This should be properly filled out by all applicants, whether entering upon certificate from a secondary school or presenting themselves for examination.

Freshman Registration. — Each freshman is expected to be in daily attendance beginning Thursday, September 26, at 9.00 A.M. and to follow the prepared program which will be placed in his hands. A program which is planned to acquaint the new student with the institution, its location and surroundings, its courses of instruction, its recreational activities and other phases of its life is arranged for the opening week. Unless arrangements for room and board are made previously, the first two days of the week may be used for this purpose. Physical examinations as well as certain other tests are given during this orientation period. Freshman week enables the student to secure the advantages which come from acquaintance with his surroundings, his instructors, the members of his class, student organizations, activities and customs. The overcrowding of the first week of classes with distractions is thus avoided.

Registration. — All upper classmen are required to register on or before the Monday of the week beginning the school year, and all students during the midyear examination period. For unexcused delay in registration a fee of $5 will be imposed.

Sessions. — The regular school sessions are in general from 9.00 A.M., to 12.50 P.M., and from 1.55 to 4.45 P.M., except Saturdays, when no classes are held. On Saturday afternoons the buildings are closed.

An hour plan designates the hours at which the various classes meet. This is rigidly adhered to, and the student is marked for his attendance and work as therein scheduled.

Attendance. — Attendance is required of all students on fourteen-fifteenths of all scheduled class exercises, provided they meet the requirements of their instructors for the omitted exercises. For every unexcused absence from any class exercise in excess of those allowed, a deduction from the mark obtained in the course in which the absences occurred will be made.

Advisers. — Advisers are appointed for all students, to be of such aid and assistance as they can both inside and outside of school hours. The head of the department in which a student is registered is adviser to upper-classmen, and instructors in charge of freshman classes act as advisers to freshmen.

Conduct. — Students are required to return to the proper place all instruments or apparatus used in experimental work, and to leave clean and in working order all machinery and apparatus with which they may experiment. All breakages, accidents or irregularities of any kind must be reported immediately to the head of the department or instructor in charge.

Irregular attendance, lack of punctuality, neglect of either school or home work, disorderly or ungentlemanly conduct or general insubordination are considered good and sufficient reasons for the immediate suspension of a student, and a report to the trustees for such action as they deem necessary to take.

It is the aim of the trustees so to administer the discipline of the Institute as to maintain a high standard of integrity and a scrupulous regard for trust. The attempt of any student to present, as his own, work which he has not performed, or to pass any examination by improper means, is regarded by the trustees as a most serious offense, and renders the offender liable to immediate suspension or expulsion. The aiding or abetting of a student in any dishonesty is also held to be a grave breach of discipline.

Any student who violates these provisions will be immediately suspended by the president, and the case reported at the following meeting of the trustees for action.

Examinations. — For first-year students examinations are held every five weeks, and these serve to inform the student concerning his standing and the progress made.

For students in upper classes examinations will be held during the eighth week of each term.

Final examinations are held at the end of each term.

In general, the examinations cover the work of the preceding term, but at the discretion of the instructor may include work of earlier terms.

Examinations for students conditioned in first-term subjects are held during the second term, and examinations for students conditioned in the second-term subjects are held in September following. Students requesting condition examinations at other than scheduled dates will be required to pay $5 for each examination so taken.

Any student who fails to complete a subject satisfactorily or to clear a condition at the time appointed, will be required to repeat the subject, and he cannot be admitted to subjects dependent thereon.

A student whose term's standing is as a whole so low that he cannot continue with profit the work of the next term will be required to leave, but he may return the following year to repeat such subjects as are required.

Daily work and regularity of attendance are considered in making up the reports of standing.

Records and Reports of Standing. — During each term informal reports are sent to parents or guardians of all students under age, and to all students; and at the end of each term formal reports are made.

The daily work of the student forms an important part of his record, and no pupil will be awarded the diploma or degree unless this portion of his record is clear.

Books are prescribed for study, for entry of lecture notes and other exercises, and are periodically examined by the lecturers. The care and accuracy with which these books are kept are considered in determining standing.

Thesis. — Each candidate for the degree of the Institute must file with the head of the department in which the thesis is taken, and not later than May 15, a report of original investigation or research, written on a good quality of paper, 8½ by 11 inches, with one-inch margin at left, and one-half inch at right, of each page; such thesis to have been previously approved by the head of the department in which it is made.

For all candidates for the diploma this requirement will be optional on the part of the Institute.

Library and Reading Room. — That the students may have surroundings conducive to reading and study a moderate-sized reading room with library tables and chairs has been provided. The library shelves contain textile, art, engineering and scientific publications. These are increased from time to time as new technical books of value to textile students are issued from the press. The leading textile papers are kept on file for ready reference.

FEES, DEPOSITS, ETC.

Tuition Fee.—The fee for the day course is $150 per year for residents of Massachusetts. For non-residents the fee for all courses is $200 per year. The fee for students from foreign countries is $300 per year.

Three-fifths of the fee is charged for a single term. Each term's tuition is payable during the first week of that term. Students failing to make this payment at the specified time will be excused from classes until satisfactory explanation and arrangements for payment can be made. *No bills will be sent.* After payment is made no fee or part thereof can be returned, except by special action of the trustees.

Special students pay, in general, the full fee, but if a course be taken involving attendance at the school during a limited time, application may be made to the president for a reduction.

Students entering from Massachusetts are required to file with the Bursar a statement signed by either town or city clerk, stating that the applicant's father is a legal resident of Massachusetts.

Athletic Fee. — An athletic fee of $15 is due and payable at the time of the first payment of tuition.

Deposits. — For all first-year students a minimum deposit of $25 is required to cover the cost of breakage, supplies, apparatus and chemicals used in the Chemical Laboratory, the unexpended balance to be returned to the student at the end of the year. For all students in second, third and fourth years taking work in Chemistry and Dyeing Laboratories a deposit of $25 for the first term and $25 for the second term is required.

Students taking Machine Shop will be required to make deposit of $15 to cover cost of materials, supplies and breakage. Included in this charge is a kit of tools which is essential to the work and which becomes the personal property of the student. The unexpended balance will be returned at the end of the year.

Students not taking Chemistry Laboratory or Machine Shop will be required to make a deposit of $10 each year to cover general breakage. The unexpended balance will be returned at the end of the year.

All deposits must be made before students can be admitted for laboratory work.

Rooms and Board. — Students from a distance, requiring rooms and board in the city, may, if they desire, select same from a list which is kept at the Institute. The cost of rooms and board in a good district is $12 per week and upwards.

Books and Materials. — Students must provide their own books, stationery, tools, etc., and pay for any breakage or damage that they cause. The above fee includes free admission for any day students desiring to attend any of the evening classes in which there is accommodation.

All raw stock and yarn furnished to the students, and all the productions of the Institute, remain or become its property, except by special arrangement; but each student is allowed to retain specimens of yarn or fabrics that he has produced, if mounted and tabulated in accordance with the requirements of the department. It is understood that the department may retain such specimens of students' work as they may determine.

Lockers are provided for the use of the students, sufficiently capacious to contain clothing, books and tools.

No books, instruments or other property of the Institute are loaned to the students to be removed from the premises except by special permission.

Summary of Expenses per Year

Tuition (residents of Massachusetts)	$150
Tuition (residents of other States)	200
Tuition (foreigners)	300
Chemistry laboratory deposit (1st year)	25
Chemistry laboratory deposit (2d, 3d and 4th years)	50
Athletic fee	15
Machine shop deposit	15
General breakage fee	10
(This applies to students who do not take chemistry or machine shop.)	
Books and supplies	50
(Books and supplies for the first year cost about $80, second and third year $35, and fourth year $50, thus averaging about $50 per year for the four years.)	

SCHOLARSHIPS AND PRIZES

The Massachusetts Charitable Mechanic Association Scholarship. — The Massachusetts Charitable Mechanic Association has offered six scholarships of $250 each which are for the purpose of defraying school expenses of such students as may be selected by a committee composed of a representative from the association, one from the Board of Trustees and the President of the Institute.

Herbert A. Currier Prize. — Herbert A. Currier, of the class of 1906, has offered a prize of $50 to a student who may be selected by the faculty of the Institute, and in making the selection the following conditions will be considered: scholastic standing, financial need, and ability in promoting student activities in school life. The scholarship will be awarded to a member of the sophomore, junior or senior class.

Edward A. Bigelow Prize. — Edward A. Bigelow, class of 1906, has offered the following cash prizes: $100 to the member of the class graduating from the Wool Manufacturing Course who maintains the highest standing throughout his three years; $50 to the member of the second-year class in the Wool Manufacturing Course who maintains the highest standing during his second year; $25 to the member of the first-year class in the Wool Manufacturing Course who maintains the highest standing during his first year.

Textile Colorist Award. — The Textile Colorist, Inc., has offered a prize of $100 to be awarded to a member of the graduating class whose thesis, based upon his personal researches and experiences, is of the greatest practical value to the dyeing, bleaching or textile finishing industries.

Louis A. Olney Book Prize. — Prizes in the form of books are awarded each year to the successful candidate on graduation day. The conditions in detail are as follows: —

First. — Ten dollars to the student taking the regular Chemistry and Textile Coloring Course who shall be considered as having attained the highest scholarship in first-year chemistry.

Second. — Five dollars to the student taking the regular Chemistry and Textile Coloring Course who shall be considered as having attained the second highest scholarship in first-year chemistry.

Third. — Ten dollars to the regular student of the Chemistry and Textile Coloring Course who shall be considered as having obtained the highest scholarship during his second year.

Fourth. — Five dollars to the regular student of the Chemistry and Textile Coloring Course who shall be considered as having attained the second highest scholarship during his second year.

Fifth. — Twenty dollars to the regular student in the Chemistry and Textile Coloring Course who shall present the best thesis preparatory to graduation.

The above-mentioned sums are to be invested in books which may be selected after graduation. In case no one is considered worthy of any particular scholarship prize, or if there is no competition, the same may be withheld. The decision in such case shall rest with the judges.

The National Association of Cotton Manufacturers Medal. — The National Association of Cotton Manufacturers offers a medal to that member of the graduating class who, during his course, shall have attained the highest standing in special subjects required by the vote of the association.

STUDENT ACTIVITIES AND ORGANIZATIONS

School Publications. — The Text is issued bi-weekly and it contains news pertaining to activities in the Institute as well as information concerning alumni. The Pickout is an annual publication in charge of a manager and editor selected from the senior class. The board is composed of representatives from the various classes.

Fraternities. — There are four fraternities, three of which are national and one is local. They afford opportunity for social life desired in a college career.

Musical and Dramatic Clubs. — The past four years the students have had a well-organized orchestra and glee club which have given very enjoyable programs within and without the city. This offers an opportunity for pleasure and profit to students who enjoy music either vocal or instrumental. The Dramatic Club gives annually a theatrical program at the Lowell Auditorium. Appropriation is made from the profits to the treasury of the Athletic Association.

Professional Clubs. — A Student Section of the American Society of Mechanical Engineers holds meetings regularly in accordance with requirements of the national organization. The Student Section of the American Society of Dyers and Colorists hold meetings at which papers are delivered or speakers come from outside the school organization. There is one Honor Society known as Tau Epsilon Sigma. Its membership is composed of students who have for the first three years maintained a particularly high scholastic standing.

Honor Roll. — The President's List includes upper classmen taking a regular course who have a general average of eighty percent and no deficiencies.

Co-operative Society. — This society is maintained for the benefit of students who desire to purchase supplies and materials for use in connection with their work. It is operated under the direction of a manager and assistant manager and one or more clerks. The general business policy is under the supervision of a member of the faculty. Students who join the society are entitled to discount privileges when purchasing from the society and from certain firms in the city of Lowell.

Alumni Association. — The Alumni Association of the Institute holds its annual meeting and banquet in May of each year.

The membership of the association is composed of graduates of the day courses and is open to any non-graduate who has attended the Institute for at least one year.

Officers for the Year 1928–29

William O. Jelleme, '10, *President.*
Edwin D. Fowle, '24, *Vice-President.*
Arthur A. Stewart, '00, *Secretary-Treasurer.*

Communications should be addressed to Arthur A. Stewart, Lowell Textile Institute.

Ex-Officio Members of Executive Committee

Edward M. Abbot, '04	Ralph K. Hubbard, '11
Henry A. Bodwell, '00	Frank L. McCool, '10
Thomas T. Clark, '10	T. Ellis Ramsdell, '02

Royal P. White, '04

Executive Committee

15 Members

Philip H. Warren, '05, *Chairman*
James F. Dewey, '04
Leonard S. Farr, '08
Russell T. Fisher, '14
Charles H. Forsaith, '20
Allen R. Fuller, '17
Olin D. Gay, '08
Arthur J. Hennigan, '06
Thomas Joy, '26
Brackett Parsons, '20
Everett B. Rich, '11
Ernest D. Walen, '14
J. Milton Washburn, '21
A. Edwin Wells, '20
Stanley H. Wheelock, '05

Cotton Yarn Department

SUBJECTS OF INSTRUCTION

In the column headed "Hours of Exercise" the numbers represent for each particular subject the total hours required in school for a period of fifteen weeks.

The letter and number which follow the subjects indicate the department in which the subject is given and the number of the subject in that department. For detailed description of the same, see page 32.

The departments are indicated as follows: —

Textile Engineering	B	Cotton Yarns	F
Chemistry and Dyeing	C	Woolen and Worsted Yarns	G
Textile Design and Power Weaving,	D	Finishing	H
Languages and History	E		

By referring to the letter and number indicated under "Preparation" the student can ascertain what subjects are necessary in order that he may have a clear understanding of the subject which he is scheduled to take.

First Year

First Term

(Common to all Courses)

	Hours of Exercise
Elementary Chemistry C–10	165
English E–10	45
Mathematics B–10	45
Mechanical Drawing B–14	90
Mechanics B–11	60
Physical Education	30
Textile Design and Cloth Analysis D–10	90

Second Term

	Course IV	Course VI
Elementary Chemistry C–10	75	75
Elementary German E–11 or Elementary French E–12	30	30
English E–10	45	45
Machine Drawing B–15 and B–15a	30	90
Mathematics B–10	45	45
Mechanical Laboratory B–13	–	30
Mechanism B–12	60	60
Physical Education	30	30
Qualitative Analysis C–12	135	–
Stoichiometry C–13	15	–
Technology of Fibers F–10, G–10 and C–11	60	60
Textile Design and Cloth Analysis D–10	–	60

For second-term subjects in Courses I, II, and III, see pages 21, 23, 25.

Course I — Cotton Manufacture

The Cotton Manufacturing Course is designed for students contemplating a career in the manufacturing of cotton yarns and cloth or allied industries, and wishing to devote but three years to instruction at the Institute.

During the first term the studies are common to all courses, and include instruction in mechanism, mathematics, mechanical drawing, textile design and elementary chemistry. Laboratory work supplements the lectures in chemistry, and weaving assists in illustrating the principles of textile design. At the commencement of the second term instruction in the preliminary processes of yarn manufacturing is given in the course of technology of fibers.

The work in the Cotton Yarn Department comprises instruction in all the manufacturing processes from the bale to the finished yarn. The instruction is given by means of lectures upon the machines and processes, and by laboratory work upon the machines themselves. In the laboratory each student is required to make exhaustive tests upon each machine, and to make as many settings and adjustments as possible. The third year's work in this department is largely devoted to lectures upon the manufacture of specialties, waste products, etc., and special laboratory work, special tests upon yarns and fabrics, mill planning with regard to the arrangement of machinery, and other work of an advanced nature.

The course in chemistry consists of lecture and laboratory work on inorganic and organic chemistry, followed by a lecture course of instruction in textile chemistry and dyeing.

The work in mechanism serves as a basis for all future machine and mechanical work, and is followed by steam engineering, electricity and mill engineering. The mechanical drawing taken in connection with these subjects augments this instruction as well as provides opportunity for students to become skilled in drafting.

The course in textile designing, cloth analysis and cloth construction includes lectures on plain and fancy weaves and Jacquard work, the analysis of all commercial fabrics, and designs for the same.

Power weaving is taken up during the second and third years. Commencing with lectures and practice upon plain looms, the instruction continues with dobby, box-loom, and Jacquard weaving.

A course in knitting taken during the third year includes the manufacture of hosiery and underwear. The course on the finishing of cotton fabrics is given by lectures and laboratory work, and requires considerable work on standard machines in the laboratory.

For detailed description of the subjects see page 32.

Course I. — Cotton Manufacture

[For first term see page 19]

First Year. Second Term. (Hours of Exercise)

Elementary Chemistry C–10	75	Physical Education	30
English E–10	45	Technology of Fibers C–11, F–10, G–10	60
Machine Drawing B–15	75	Textile Design and Cloth Analysis D–10	135
Mathematics B–10a	45		
Mechanism B–12	60		

Second Year. First Term

Chemistry and Dyeing Lect. C–21	30	Power Weaving D–22	90
Cotton Yarn Mfg. F–20	195	Steam Engineering B–24	45
Industrial History E–22	15	Textile Design and Cloth Analysis D–20	75
Machine Drawing B–21	30		
Physics B–22	45		

Second Year. Second Term

Chemistry and Dyeing Lect. C–21	15	Power Weaving D–22	120
Cotton Yarn Mfg. F–20	210	Steam Engineering B–25a	15
Industrial History E–22	15	Textile Design and Cloth Analysis D–20	60
Machine Drawing B–21	45		
Physics B–22	45		

Third Year. First Term

Cotton Finishing H–31	75	Mill Engineering B–35a	30
Cotton Yarn Mfg. F–30	195	Power Weaving D–31	120
Electricity B–34a	30	Textile Testing G–31	15
Knitting F–31	60		

Third Year. Second Term

Cotton Finishing H–31	75	Power Weaving D–31	135
Cotton Yarn Mfg. F–30	240	Textile Testing G–31	15
Knitting F–31	60	Thesis.	

Course II. — Wool Manufacture

The course on wool manufacturing is arranged for those who contemplate a career in the manufacture of woolen or worsted fabrics, and can devote but three years to the school work. It includes instruction on all of the varied processes employed in manipulating the wool fiber to produce yarn and cloth, namely, sorting, scouring, carding, combing, spinning, designing, weaving, dyeing and finishing. The work is carried on by lectures, recitations and practical work in the laboratories.

Following the first term of the first year, which is common to all courses, the student taking technology of fibers becomes acquainted not only with the various kinds of wool and trade terms applied to them, but also with other commercial fibers, viz., cotton, silk, jute, hemp, flax, etc., used in the textile industry. He is at the same time taught the application of these fibers and the general processes of manufacturing each into a yarn.

Beginning with the second year the details of manipulating wool from the grease to the finished yarn is taken up for close study. This includes the spinning of woolen yarn, also worsted yarn, by both the English and the French systems. The intermediate processes of sorting, scouring, carding, combing and top-manufacturing are taken in detail and in proper sequence.

The general chemistry of the first year is followed by a lecture course in the second year on textile chemistry and dyeing.

Textile design, cloth analysis and construction are continued from the first year throughout the course, the work being applied especially to woolen and worsted goods. Weaving on power looms commences in the second year and continues through the third.

Lectures on finishing commence with the third year and are augmented by extensive practice with the machines in the Finishing Department.

Work in the Engineering Department extends throughout all three years, and includes mechanical drawing, steam engineering and electricity. The practical application of the principles studied in these subjects is brought out forcibly in the work on mill engineering, where mill design and construction are considered. A short course covering methods employed in the testing of fibers, yarns, and cloths, together with laboratory work in the manipulation of certain physical apparatus, is given in the third year.

For detailed description of the subjects see page 32.

Course II. — Wool Manufacture

[For first term see page 19]

FIRST YEAR. SECOND TERM. (HOURS OF EXERCISE)

Elementary Chemistry C–10	75	Physical Education	30
English E–10	45	Technology of Fibers G–10, F–10 C–11	60
Machine Drawing B–15	75	Textile Design and Cloth Analysis D–10	135
Mathematics B–10a	45		
Mechanism B–12	60		

SECOND YEAR. FIRST TERM

Chemistry and Dyeing Lect. C–21	30	Steam Engineering B–24	45
Industrial History E–22	15	Textile Design and Cloth Analysis D–21	90
Machine Drawing B–21	30	Top Manufacture G–20	210
Physics B–22	45		
Power Weaving D–22	60		

SECOND YEAR. SECOND TERM

Chemistry and Dyeing Lect. C–21	15	Steam Engineering B–25a	15
Industrial History E–22	15	Textile Design and Cloth Analysis D–21	60
Machine Drawing B–21	45	Top Manufacture G–20	255
Physics B–22	45		
Power Weaving D–22	75		

THIRD YEAR. FIRST TERM

Electricity B–34a	30	Power Weaving D–31	120
Finishing H–30	75	Textile Testing G–31	15
Knitting F–31	60	Yarn Manufacture G–30	195
Mill Engineering B–35a	30		

THIRD YEAR. SECOND TERM

Finishing H–30	75	Textile Testing G–31	15
Knitting F–31	60	Yarn Manufacture G–30	255
Power Weaving D–31	120	Thesis.	

Course III. — Textile Design

The general course in textile design is planned to meet the demand of young men for a technical training in the general processes of textile manufacturing, but with particular reference to the design and construction of fabrics. To this end a foundation is laid in the first year by instruction in the elementary principles of designing, decorative art and weaving. That he may later in the course pursue to advantage instruction in yarn manufacturing, weaving, dyeing, finishing and some engineering problems, a foundation course in mechanics, mathematics and chemistry is laid. As the student is required to pursue courses in the yarn departments, both cotton and wool, he acquires a knowledge of the manufacture of cotton yarns from the bale to the yarn, and of woolen and worsted yarns from the fleece through the varied processes of manufacturing woolen yarn or worsted yarn by both the French and Bradford systems.

Throughout his entire course he receives instruction in design, cloth analysis and construction of all the standard cloths, viz., trouserings, coatings, suitings, blankets, velvets, corduroys, plushes, etc. This is followed by advanced work in Jacquard designing and weaving, which serves not only to acquaint the student with the many kinds of cotton, woolen, worsted and silk fabrics of figured design, but stimulates and develops any artistic talent he may possess. Decorative art becomes an important part of the work of the second and third years.

The course in general inorganic and organic chemistry of the first year leads to the subject of textile chemistry and dyeing in the second year.

Power weaving commences with the second year and continues throughout the course, and work on all types of looms is required.

During the third year the student receives instruction in the finishing of cotton goods and woolen and worsted cloths. This instruction is given by means of lecture and laboratory work.

The engineering subjects given in the second and third years are intended to acquaint the student with such general knowledge as will be of assistance should he be called upon in later life to be a mill manager, or should his subsequent progress lead to some executive position in the operation of a textile plant.

For detailed description of the subjects see page 32.

Course III. — Textile Design

[For first term see page 19]

First Year. Second Term. (Hours of Exercise)

Elementary Chemistry C–10	75	Physical Education	30
English E–10	45	Tech. of Fibers C–11, F–10, G–10	60
Machine Drawing B–15	75	Textile Design and Cloth Analysis D–10	135
Mathematics B–10a	45		
Mechanism B–12	60		

Second Year. First Term

Chemistry and Dyeing Lect. C–21	30	Power Weaving D–22	60
Cotton Yarn Mfg. F–20a	150	Steam Engineering B–24	45
Industrial History E–22	15	Textile Design and Cloth Analysis D–20, 21	150
Machine Drawing B–21	30		
Physics B–22	45		

Second Year. Second Term

Chemistry and Dyeing Lect. C–21	15	Power Weaving D–22	75
Cotton Yarn Mfg. F–20a	75	Steam Engineering B–25a	15
Industrial History E–22	15	Textile Design and Cloth Analysis D–20, 21	135
Machine Drawing B–21	45	Top Manufacture G–20	105
Physics B–22	45		

Third Year. First Term

Cotton Finishing H–31	75	Textile Design and Cloth Construction D–30	120
Electricity B–34a	30	Textile Testing G–31	15
Knitting F–31a	15	Wool Finishing H–30	75
Mill Engineering B–35a	30	Yarn Manufacture G–30a	90
Power Weaving D–31	75		

Third Year. Second Term

Cotton Finishing H–31	75	Textile Testing G–31	15
Knitting F–31a	15	Wool Finishing H–30	75
Power Weaving D–31	75	Yarn Manufacture G–30a	90
Textile Design and Cloth Construction D–30	180	Thesis.	

Course IV. — Chemistry and Textile Coloring

The four-year course in Chemistry and Textile Coloring, leading to the degree of B.T.C., is especially intended for those who wish to engage in any branch of textile chemistry, textile coloring, bleaching, finishing or the manufacture and sale of the dyestuffs or chemicals used in the textile industry. The theory and practice of all branches of dyeing, printing, bleaching, scouring and finishing are taught by lecture work supplemented by a large amount of experimental laboratory work and actual practice in the dyehouse and finishing room.

The underlying theories and principles of chemistry are the same, no matter to what industry the application is eventually made. Furthermore, no industry involves more advanced and varied applications of the science of chemistry than those of the manufacture and application of the coal-tar coloring matters. In addition, the textile colorist must consider the complex composition of the textile fibers, and the obscure reactions which take place between them and the other materials of the textile industry.

During the first year general chemistry, including both inorganic and organic, is taught by lectures and laboratory work, and this is supplemented during the second term by qualitative analysis and stoichiometry.

Advanced inorganic chemistry, as well as advanced organic chemistry, is studied during the second and third year as a continuation of the elementary chemistry of the first year, and much time is spent upon quantitative analysis, industrial chemistry, and textile chemistry and dyeing.

The foundation work in general chemistry is continued during the third year with courses in physical chemistry, organic laboratory work and analytical work. The subject of industrial chemistry is introduced, and much time is devoted to advanced textile chemistry, dye testing, color matching, calico printing and woolen, worsted and cotton finishing.

The fourth year is characterized by an endeavor to present certain subjects of a more applied nature in such a manner that the student's reasoning power and ability to apply the knowledge gained during the first three years may be developed to the fullest extent. The subject of engineering chemistry is introduced, and the work in the Dyeing and Analytical Laboratories is applied as far as possible to the actual requirements of the factory chemist and colorist. The student is given a thorough course in microscopy, photomicrography and the use of the various instruments, such as the spectroscope, ultra-microscope, polariscope, tintometer, etc., which often prove of vital importance in the advanced study of textile chemistry. During this fourth year the student devotes much time in the Organic Laboratory in the manufacture of dyestuffs. This is followed by some research work or original investigation as time will permit. Upon this he must present a satisfactory thesis, or report, before receiving his degree.

For detailed description of the subjects see page 32.

Course IV. — Chemistry and Textile Coloring

[For first year see page 19]

Second Year. First Term. (Hours of Exercise)

Advanced German E–21	30	Physics B–22	45
Adv. Inorganic Chemistry C–23	30	Quantitative Analysis C–25	195
Textile Chemistry and Dyeing Lab. C–22	75	Steam Engineering B–24	45
Industrial History E–22	15	Stoichiometry C–20	15
Mathematics B–20a	45	Textile Chemistry and Dyeing Lect. C–21	30

Second Year. Second Term

Advanced German E–21	30	Steam Engineering B–25a	15
Adv. Inorganic Chemistry C–23	30	Stoichiometry C–20	15
Adv. Organic Chemistry C–24	30	Textile Chemistry and Dyeing Lab. C–22	135
Industrial History E–22	15	Textile Chemistry and Dyeing Lect. C–21	15
Mathematics B–20a	45		
Physics B–22	45		
Quantitative Analysis C–25	150		

Third Year. First Term

Adv. Organic Chemistry Lect. C–34	30	Economics E–30	30
Adv. Textile Chemistry and Dyeing Lab. C–32	135	Industrial Chemistry C–31	30
Adv. Textile Chemistry and Dyeing Lect. C–32	30	Quantitative Analysis C–30	165
		Technical German C–35	30
		Wool Finishing H–30	75

Third Year. Second Term

Adv. Textile Chemistry and Dyeing Lab. C–32	75	Organic Laboratory C–36	120
Adv. Textile Chemistry and Dyeing Lect. C–32	15	Physical Chemistry C–33	30
Economics E–30	30	Quantitative Analysis C–30	120
Industrial Chemistry C–31	30	Technical German C–35	30
		Wool Finishing H–30	75

Fourth Year. First Term

Adv. Textile Chemistry and Dyeing Lab. C–45	135	Physical Chemistry C–44	45
Adv. Textile Chemistry and Dyeing Lect. C–45	30	Quantitative Analysis C–47	15
Engineering Chemistry C–42	15	Report Writing C–48	15
Industrial Laboratory C–43	45	Technical German C–40	30
Organic Laboratory C–41	90	Textile Testing G–31	15
		Thesis C–49	90

Fourth Year. Second Term

Adv. Textile Chemistry and Dyeing Lab. C–45	90	Organic Laboratory C–41	105
Adv. Textile Chemistry and Dyeing Lect. C–45	15	Physical Chemistry C–44	15
Engineering Chemistry C–42	30	Report Writing C–48	15
Microscopy C–46	45	Technical German C–40	30
		Textile Testing G–31	15
		Thesis C–49	165

Course VI. — Textile Engineering

This course is the four-year general textile course leading to the degree of Bachelor of Textile Engineering (B.T.E.), and aims especially to fit men, in the broadest possible manner, to meet the increasing demands of every branch of the textile industry for men with combined textile and technical preparation. The magnitude and scope of the textile and allied industries fully justify the most thorough technical training possible for all who aspire to leadership in this field.

The student is first thoroughly grounded in those fundamental principles of science upon which all industrial and engineering work rests. The foundation of his textile and technical training is in the subjects of mathematics, physics, chemistry, drawing, mechanics, mechanism, and technology of fibers, and their practical application.

Instruction is given in all of the various branches of textile manufacturing through lectures, recitations and laboratory work. A large proportion of his time is spent in well-equipped textile departments where he studies and operates all of the machinery required in the conversion of cotton and wool fiber into yarns and fabrics. This includes cotton, wool and worsted yarn manufacturing, designing, weaving, knitting, dyeing and finishing. In his last year the course in textile testing acquaints the student with the methods for determining the physical properties of textile fibers, yarns and fabrics.

To properly equip the student to meet the varied engineering problems which confront the mill manager or executive, or to so train him that he may enter those industries closely allied to the textile, instruction is given by lecture and laboratory practice in the several branches of engineering.

Steam engineering considers the problems involved in steam generation and distribution for power, heating and manufacturing purposes, includes the testing of laboratory and power plant equipment, and leads to the design of power plants. The course in electrical engineering includes a study of the generation and transmission of electrical power, the testing of direct and alternating current machinery, and is intended to acquaint the student with modern practice.

Mill engineering familiarizes the student with mill design, construction, heating, lighting, humidification and fire protection. The arrangement of machinery and buildings for most efficient production and economical power distribution is also studied in detail.

During the fourth year the student is required to conduct an original investigation of some textile or allied problem, and to submit the results in the form of a satisfactory thesis before receiving his degree.

The broadening effect of such subjects as English, language, industrial history and economics is carried still further in this course by carefully planned courses in business administration, accounting, cost accounting, business and patent law.

For the student who may desire the breadth of technical training which this course offers, but who wishes to specialize in either cotton or wool manufacturing, two options are offered. In these optional courses the student's entire textile time is devoted to the study of that particular fiber which he elects.

For detailed description of subjects, see page 32.

Course VI. — Textile Engineering (General Course)

[For first year see page 19]

Second Year. First Term. (Hours of Exercise)

Chemistry and Dyeing Lect. C–21	30	Mathematics B–20	45
Cotton Yarn Mfg. F–20a	45	Physics B–22	45
Engineering Lab. B–26	45	Power Weaving D–22	30
Industrial History E–22	15	Steam Engineering B–24	45
Language E–20, 21	30	Wool Yarn Mfg. G–20	120
Machine Drawing B–21	75		

Second Year. Second Term

Cotton Yarn Mfg. F–20a	75	Physics B–22	45
Engineering Lab. B–26	45	Power Weaving D–22	30
Graphic Statics B–23	30	Steam Engineering B–25	30
Industrial History E–22	15	Textile Chemistry and Dyeing Lect. C–21	15
Language E–20, 21	30	Wool Yarn Mfg. G–20	90
Machine Drawing B–21	75		
Mathematics B–20	45		

Third Year. First Term

Cotton Yarn Mfg. F–30a	60	Mill Engineering B–35	45
Economics E–30	30	Power Weaving D–31	45
Electrical Engineering B–34	75	Strength of Materials B–32	30
Engineering Lab. B–31	45	Wool Finishing H–30	75
Mathematics B–30	30	Wool Yarn Mfg. G–30	90

Third Year. Second Term

Cotton Yarn Mfg. F–30a	60	Mill Engineering B–35	45
Economics E–30	30	Power Weaving D–31	45
Electrical Engineering B–34	75	Strength of Materials B–32	30
Hydraulics B–33	15	Wool Finishing H–30	75
Machine Shop Practice B–36	30	Wool Yarn Mfg. G–30	90
Mathematics B–30	30		

Fourth Year. First Term

Businesss Administration B–44	45	Machine Shop Practice B–40	45
Cotton Finishing H–31	30	Mill Engineering B–43	75
Cotton Organization F–40	75	Power Plants B–42	30
Elements of Accounting B–46	45	Textile Testing G–31	15
Electrical Engineering B–41	75	Thesis	75
Knitting F–31a	15	Electives B–49	

Fourth Year. Second Term

Business Administration B–44	30	Knitting F–31a	15
Business Law B–48	15	Mill Engineering B–43	75
Cost Accounting B–47	45	Power Plants B–42	30
Cotton Finishing H–31	75	Textile Testing G–31	15
Cotton Organization F–40	15	Thesis	135
Electrical Engineering B–41	75	Electives B–49	

Course VI. — Textile Engineering (Cotton Option)

[For first year see page 19]

Second Year. First Term. (Hours of Exercise)

Cotton Yarn Mfg. F–20a	165	Physics B–22	45
Engineering Lab. B–26	45	Power Weaving D–22	30
Industrial History E–22	15	Steam Engineering B–24	45
Language E–20, 21	30	Textile Chemistry and Dyeing Lect. C–21	30
Machine Drawing B–21	75		
Mathematics B–20	45		

Second Year. Second Term

Cotton Yarn Mfg. F–20a	165	Mathematics B–20	45
Engineering Lab. B–26	45	Physics B–22	45
Graphic Statics B–23	30	Power Weaving D–22	30
Industrial History E–22	15	Steam Engineering B–25	30
Language E–20, 21	30	Textile Chemistry and Dyeing Lect. C–21	15
Machine Drawing B–21	75		

Third Year. First Term

Cotton Finishing H–31	75	Mill Engineering B–35	45
Cotton Yarn Mfg. F–30a	90	Power Weaving D–31	30
Economics E–30	30	Strength of Materials B–32	30
Electrical Engineering B–34	75	Textile Design and Cloth Analysis D–20	75
Engineering Lab. B–31	45		
Mathematics B–30	30		

Third Year. Second Term

Cotton Finishing H–31	75	Mathematics B–30	30
Cotton Yarn Mfg. F–30a	75	Mill Engineering B–35	45
Economics E–30	30	Power Weaving D–31	90
Electrical Engineering B–34	75	Strength of Materials B–32	30
Hydraulics B–33	15	Textile Design and Cloth Analysis D–20	30
Machine Shop Practice B–36	30		

Fourth Year. First Term

Business Administration B–44	45	Mill Engineering B–43	45
Cotton Organization F–40	75	Power Plants B–42	30
Electrical Engineering B–41	75	Textile Design D–30	30
Elements of Accounting B–46	45	Textile Testing G–31	15
Knitting F–31a	60	Thesis	75
Machine Shop Practice B–40	30	Electives B–49	

Fourth Year. Second Term

Business Administration B–44	30	Mill Engineering B–43	75
Business Law B–48	15	Power Plants B–42	30
Cost Accounting B–47	45	Textile Design D–30	30
Cotton Organization F–40	45	Textile Testing G–31	15
Electrical Engineering B–41	75	Thesis	105
Knitting F–31a	60	Electives B–49	

Course VI. — Textile Engineering (Wool Option)

[For first year see page 19]

SECOND YEAR. FIRST TERM. (HOURS OF EXERCISE)

Engineering Lab. B–26	45	Power Weaving D–22	30
Industrial History E–22	15	Steam Engineering B–25	45
Language E–20, 21	30	Textile Chemistry and Dyeing Lect. C–21	30
Machine Drawing B–21	90	Wool Yarn Manufacture G–20	150
Mathematics B–20	45		
Physics B–22	45		

SECOND YEAR. SECOND TERM

Engineering Lab. B–26	45	Physics B–22	45
Graphic Statics B–23	30	Power Weaving D–22	30
Industrial History E–22	15	Steam Engineering B–25	30
Language E–20, 21	30	Textile Chemistry and Dyeing Lect. C–21	15
Machine Drawing B–21	75	Wool Yarn Manufacture G–20	165
Mathematics B–20	45		

THIRD YEAR. FIRST TERM

Economics E–30	30	Power Weaving D–31	45
Electrical Engineering B–34	75	Strength of Materials B–32	30
Engineering Lab. B–31	45	Wool Yarn Manufacture G–30	105
Mathematics B–30	30	Woolen and Worsted Finishing H–30	75
Mill Engineering B–35	45		

THIRD YEAR. SECOND TERM

Economics E–30	30	Power Weaving D–31	90
Electrical Engineering B–34	75	Strength of Materials B–32	30
Hydraulics B–33	15	Wool Yarn Manufacture G–30	105
Machine Shop Practice B–36	30	Woolen and Worsted Finishing H–30	75
Mathematics B–30	30		
Mill Engineering B–35	45		

FOURTH YEAR. FIRST TERM

Business Administration B–44	45	Power Plants B–42	30
Electrical Engineering B–41	75	Textile Testing G–31	15
Elements of Accounting B–46	45	Woolen and Worsted Design D–21	45
Knitting F–31a	15	Worsted Yarn Manufacture G–30	75
Machine Shop Practice B–40	30	Thesis	75
Mill Engineering B–43	75	Electives B–49	

FOURTH YEAR. SECOND TERM

Business Administration B–44	30	Power Plants B–42	30
Business Law B–48	15	Textile Testing G–31	15
Cost Accounting B–47	45	Woolen and Worsted Design D–21	30
Electrical Engineering B–41	75	Worsted Yarn Manufacture G–30	45
Knitting F–31a	15	Thesis	135
Mill Engineering B–43	75	Electives B–49	

SUBJECTS OF INSTRUCTION

TEXTILE ENGINEERING DEPARTMENT — B

Mathematics — B–10. Preparation: Admission Requirements. The work in the first term consists of plane trigonometry, logarithms, and instruction in the use of the slide-rule. Right and oblique triangles are solved by means of natural and logarithmic functions, and the various algebraic relations among the trigonometric functions are proved and used in identities and equations. Significant figures and the use of approximate data in calculations are also discussed.

In the second term the following topics are taken up: graphical and mathematical solution of quadratic and simultaneous equations, theory of equations, partial fractions, Naperian logarithms, equations of the straight line, and equations of various curves. [Courses IV and VI.]

Mathematics — B–10a. Preparation: Admission Requirements. This subject in the first term is identical with B–10, but excludes some of the topics given in the second term of B–10. [Courses I, II, III.]

Mechanics — B–11. Preparation: Admission Requirements. Taken simultaneously with B–10. This subject is required as a necessary preparation for all courses, and sixty hours of lecture and recitation time are devoted to it during the first term of the first year. The fundamental principles of this subject are considered absolutely essential to a thorough understanding of the operation of all machinery, textile or otherwise. Some of the topics treated in this course are linear and angular velocity, uniform and accelerated motion, mass, momentum, inertia, effect of force in producing motion, centrifugal force, work, power, energy, principle of moments and its applications, parallelogram and triangle of forces with applications, resolution and composition of forces, the mechanical principles represented by the wheel and axle, differential pulley block, common pulley blocks, jackscrew, worm and wheel, and inclined plane. [All courses.]

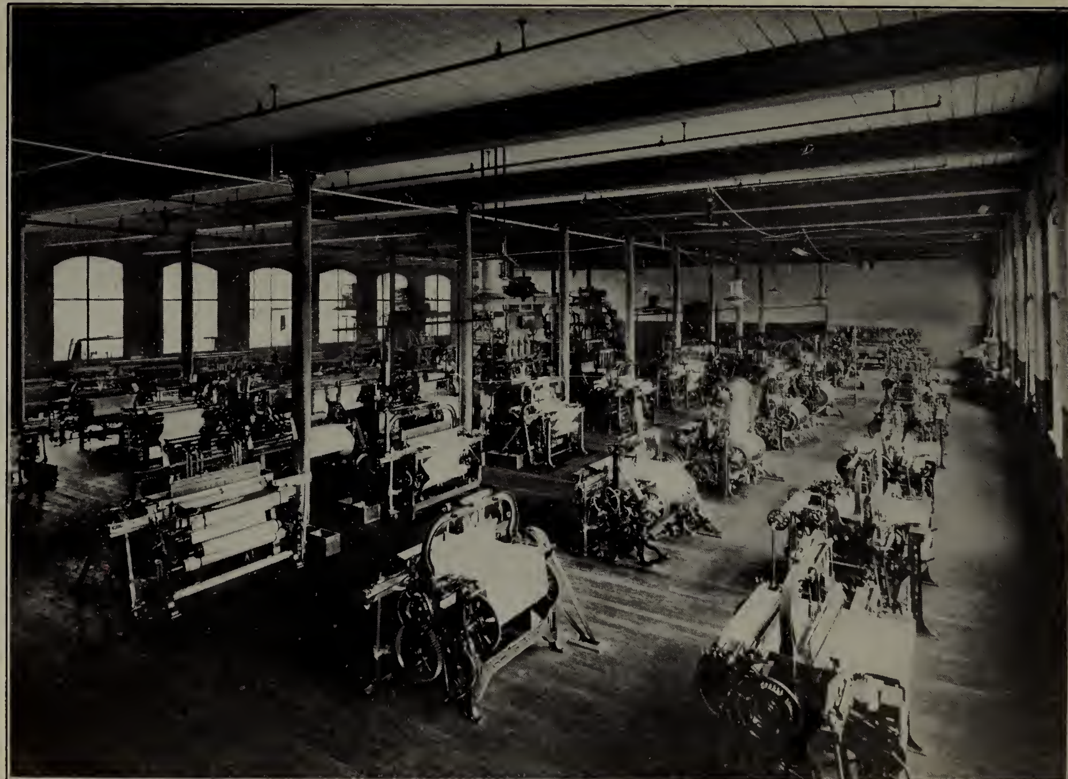
Mechanism — B–12. Preparation: B–10 and B–11. This subject is also deemed to be one of those absolutely essential to every student's preparation for the work of the following years, and sixty hours during the second term of the first year are allowed for it. Whereas the principles studied are of general application, textile machinery in particular furnishes an unusually large variety of specific examples, and frequent reference is made to these in the development of the course. Some of the important topics covered are gearing and gear train design, belting and pulley calculations, cone and stepped pulley design, cam design, linkages, epicyclic gear trains, and intermittent motion devices. [All courses.]

Mechanical Laboratory — B–13. Preparation: B–10 and B–11. Taken simultaneously with B–12. This work is given during the second term of the first year, and is supplementary to the course in Mechanics and Mechanisms. Especial importance is attached to the demonstration of the fundamental principles of these subjects. Some of the experiments and tests made in this course are as follows: —

Determination of coefficient of friction; proof of principle of moments; proof of principle of work; efficiency test of various hoisting and lifting appliances, such as tackle and fall, worm block, differential and triplex blocks, jackscrews, wedges, etc.; experimental proofs of the principles of graphic statics; efficiency tests on belt transmission, including measurement of belt tensions, coefficient of friction, slip, etc.

Tests on various types of absorption dynamometers; calibration of transmission dynamometer; power measurements on textile machinery with differential dynamometer; measurement of friction of steam engine. [Course VI.]

Mechanical Drawing — B–14. Preparation: Admission Requirements. Taken simultaneously with B–11. This course is taken during the first year, and consists of work in the drawing room supplemented by lectures. This subject is considered of the greatest importance as a preparation for the student's future work, and the practical usefulness of drawing of this character is fully emphasized. The course is systematically laid out covering in order the following divisions: —



Weave Room

Care and use of drawing instruments; geometrical constructions; elements of projections and descriptive geometry; isometric projection; developments with practical applications; sketching practice on machine details. [All courses.]

Machine Drawing — B–15. Preparation: B–14. This course is the continuation of Mechanical Drawing, and is pursued throughout the second term of the first year. The work is wholly of a practical character, and includes sketching from the textile machinery details, working scale detail and assembly drawing, tracing and blue-printing. The rudiments of machine design to supplement the work in strength of materials is also given. [Courses I, II, III, VI.]

Machine Drawing — B–15a. Preparation: B–14. For students electing the Chemistry and Textile Coloring course in the second term of the first year a course of machine drawing is given similar to B–15, except that it is not as extensive and is concluded in thirty hours. [Course IV.]

Mathematics — B–20. Preparation: B–10. This subject is a continuation of the work of the first-year course B–10, and extends throughout the second year of the engineering course. A study of the derivative is followed by the differentiation of algebraic functions and applications of the derivative to maximum and minimum and rate problems. Other topics treated are the circle, parabola, ellipse, hyperbola, indefinite integrals, summation by integration, areas, volumes and pressures. [Course VI.]

Mathematics — B–20a. Preparation: B–10a. The work in this subject is similar to that of B–20 and is given for students of chemistry and textile coloring. [Course IV.]

Machine Drawing — B–21. Preparation: B–12, B–14, B–15. During the second year the work in Machine Drawing is devoted to advanced graphical mechanism problems. The data for all of these problems are in every case taken directly from some of the textile machines that the students meet in other departments. These problems include cam designs for builder motions, mule scroll layouts, Scaife builder motion analysis, fly frame cone design, mule quadrant motion, analysis of camless winder, and a number of others of similar character. [Courses I, II, III, VI.]

Physics — B–22. Preparation: B–10 and B–11. This subject lays the foundation for later work in engineering and chemistry and also explains the general application of the laws and principles of physics. Instruction, consisting of lectures, demonstrations, and recitations, is given for three hours per week during the second year. The topics taken up the first term are: — thermometry, measurement of heat, change of state, expansion, transfer of heat, humidity, hydrostatics, elements of hydraulics, the vernier, kinetic energy, circular motion, harmonic motion, wave motion and sound.

The second term is devoted to the study of light, magnetism, and electricity. Some of the topics are: — nature and propagation of light, reflection and refraction lenses, the telescope and microscope, the spectroscope, color sensation, double refraction, magnetism, electrostatics, fundamental laws of direct currents and electrolysis. [All courses.]

Graphic Statics — B–23. Preparation: B–10 and B–11. The work in this course is presented by lecture and recitations. First are considered mathematical and graphical conditions for equilibrium for any system of forces, and the subjects of cênter of gravity and funicular polygons are introduced. Then follow problems on bridge and roof trusses under various conditions of dead, live, wind and snow loading. [Course VI.]

Steam Engineering — B–24. Preparation: B–10, B–11, B–12. The purpose of this course is to familiarize the student with the principles of elementary thermodynamics, the properties of steam, mechanical mixtures, combustion of fuels, types of boilers, and the auxiliaries of the modern boiler house. The course consists of forty-five exercises given in the first term of the second year. The lectures and recitations are supplemented with illustrative problems assigned for home preparation. [All courses.]

Steam Engineering — B–25. Preparation: B–24. This course is a continuation of B–24, and consists of thirty hours of lectures and recitations given in the

second term of the second year of the Textile Engineering course. The subjects developed are the kinematics of reciprocating steam engines, steam turbines and gas engines. Special attention is given to the mechanical principles on which the steam engine operates, with detail discussion of the valve gear and governing devices, and the various diagrams used for studying the same. Consideration is given to the underlying heat theory and to the details of construction of the various parts of the machines. During the latter part of the course the historical development, classification and types of turbines and gas engines are discussed. [Course VI.]

Steam Engineering — B-25a. Preparation: B-24. This course consists of fifteen lectures and is supplementary to Course B-24. Its aim is to give those students who do not take the Engineering course a general knowledge of the steam engine, steam turbine and gas engine, and their auxiliaries. One exercise is devoted to an engine test to demonstrate the practical use of the indicator and the advantages of condensing. [Courses I, II, III, IV.]

Engineering Laboratory — B-26. Preparation: B-24. The principles underlying the subjects of steam engineering, hydraulics and thermodynamics are demonstrated in a practical manner in the work in the Engineering Laboratory. Greater importance is attached to the development of initiative and responsibility in the student than the mere accomplishment of a large number of carefully planned tests. The character of this work is indicated by the following list of experiments and tests: —

Calibration of scales, tanks, gauges, inductors and counters; barrel, separating, and throttling calorimeter tests; heat exchange tests; boiler inspection and measurement; flue gas analysis; dynamometer tests; ejector and injector tests; Rankin's efficiency, actual thermal efficiency and duty tests; expansion of pipes, radiation and pipe covering tests; boiler test; trap tests, feed water heating tests; steam, triplex and centrifugal pump tests. [Course VI.]

Mathematics — B-30. Preparation: B-20. During the third year applications of calculus to mechanics are emphasized. The topics are as follows: integration by parts, integration by substitution, partial fractions, polar co-ordinates, centers of gravity, moments of inertia, radius of curvature, deflection of beams and empirical formulas. [Course VI.]

Engineering Laboratory — B-31. Preparation: B-26. This course is a continuation of course B-26. The following list of experiments indicates the character of the work done during the first half of the third year: —

Valve setting by measurement and by indicator; condenser test; non-condensing and condensing engine and turbine tests; heating and ventilating fan tests; lap and butt riveted joint test; nozzle test; gas engine test, flow of air and air compressor tests. [Course VI.]

Strength of Materials — B-32. Preparation: B-12, B-20, B-23. This subject consists of sixty exercises given in the third year of the Textile Engineering course, and in which are discussed, as fully as time permits, such topics as stress, strain, methods of testing materials, bending moments, shearing force, beam design, column design, torsion, design of shafts, compound beams and columns, combined stresses, etc. The subject is preparatory to the work in Mill Engineering of both the third and fourth years, where its practical value and application are clearly demonstrated. [Course VI.]

Hydraulics — B-33. Preparation: B-20 and B-25. This subject is presented by means of lectures covering the principles of hydraulics, including hydrostatics, measurements of flow of water through orifices, pipes, nozzles and over weirs. The different types of turbines are studied with results of tests and rating tables. [Course VI.]

Electrical Engineering — B-34. Preparation: B-22. The elementary principles of electricity and magnetism are considered in the lecture course of physics. Their development and application are taken up in this course in a detailed study of the magnetic and electric circuits during the first period of the first term. The second period is devoted to a study of the principles of direct current machinery. The laboratory work consists of a study of technical electrical measurements and dynamo-electric machinery, determining for the latter their operating characteristics.

The second term is devoted entirely to a study of the principles of alternating current circuits, including vector representation, effective values, power, series and parallel circuits. The laboratory work consists of a study of technical electrical measurements, some meter calibration including that of watt-hour meters and a study of alternating current circuits using electrical measuring instruments. [Course VI.]

Electricity — B–34a. Preparation: B–22. This is a short course given in the third year of the manufacturing courses, and consists of thirty lectures covering briefly and in a general way the theory of direct and alternating current generators and motors. [Courses I, II, III.]

Mill Engineering — B–35. Preparation: B–12, B–20, B–21, B–23, B–32. Mill Engineering, as presented in thirty lectures during the third year of the Textile Engineering course, consists of a discussion of the following topics: the selection of a site for a manufacturing plant; the exploration of the subsoils for the footing course of the foundation; wood, concrete and sheet steel piling; design of walls, columns, beams, floors, windows, doors, stairways and roofs.

Sixty hours of drawing-room and laboratory practice are devoted to plane surveying, contour plotting, cut and fill calculations, setting of batter boards, alignments of shafting and the study from blue-prints of slow-burning construction. [Course VI.]

Mill Engineering — B–35a. Preparation: B–10, B–12, B–21. Mill Engineering, as presented in thirty lectures during the third year of the diploma courses, is largely general in its nature and includes only parts of Course B–35. [Courses I, II, III.]

Machine Shop Practice — B–36. Preparation B–11 and B–12. Systematic instruction is given in the most approved methods of machine shop practice, the object being to familiarize the student with the proper use of hand and machine tools, and the characteristics of the different materials worked. Particular attention is given to the form, setting, grinding and tempering of tools and the mechanism of the different machines involving certain speeds, feeds, etc. The course is so planned that the instruction in each typical operation shall conform as nearly as possible to commercial machine-shop practice on textile machinery. The list of tools which appears under "Equipment" in this Bulletin gives an idea of the scope of the work, which includes chipping and filing, tool grinding and tempering, straight and taper turning, screw cutting, drilling and boring, planer work; milling machine work, including gear cutting. Instruction is also given in the use of woodworking tools, both hand and machine, and in forging. [Course VI.]

Machine Shop Practice — B–40. Preparation: B–36. This is a continuation of Course B–35.

Electrical Engineering — B–41. Preparation: B–34. During the first term a detailed study of the alternator is made, with particular stress on generation of three-phase currents. Methods of predetermination of alternator regulation are taken up and at least one method compared with laboratory test. Parallel operation of alternators with accompanying instruments and devices are studied in classroom and laboratory. The single phase, three-phase and Scott transformers are considered in turn and their various methods of connecting to line and alternators are systematically studied.

In the second term the induction motor and generator are studied with their particular adaptability to the textile industry. The principal starting devices for this motor are thoroughly taken up. The synchronous motor is studied particularly in relation to its ability to correct power factor. In all the work outlined above, the main features are illustrated profusely in classroom demonstrations and laboratory exercises.

Mill Illumination

Fourteen lectures and six laboratory periods. The various factors entering into the design of lighting installations are carefully considered. Costs and estimates, safety and production, are included in the course.

The laboratory exercises include the study and applications of the photometer, Macbeth Illuminometer and foot-candle meter. The concluding work is

design of a lighting installation for a typical mill room, using the school laboratories for this purpose. [Course VI.]

Power Plants — B-42. Preparation: B-25. This course, which consists of lectures given during the fourth year, takes up the fundamental consideration involved in the planning of a power plant for a textile mill. A standard textbook is used in connection with the lectures, and the problems are taken largely from plans of existing modern plants. The choice of type and size of units for certain conditions are given particular attention. [Course VI.]

Mill Engineering — B-43. Preparation: B-11, B-12, B-21, B-36. This work, given in the fourth year of the Textile Engineering course, covers a wide range of subjects and is of the most practical character possible. All of the student's previous work in engineering and his knowledge of the textile processes are here brought together in the consideration of the larger problems of mill design, construction and organization. After a detailed study has been made of the most modern types of mill buildings, including all calculations and drawings, the student is given the problem of laying out and completely designing a textile mill so far as time permits.

The modern methods of power transmission and the proper arrangement of textile machinery are also given careful consideration. The problems are in every case taken from actual conditions in mills already built or in process of construction. The question of mill heating, ventilation, lighting, humidification and fire protection is also studied, and the time spent in the drawing room enables the student to work out nearly all of the more important problems involved in the design of an entire textile mill plant. The close relation existing between proper plant design and economical production is also considered. [Course VI.]

Business Administration — B-44. Preparation: B-10 and E-30. In recognition of the great advances which have been recently made towards better methods of management, and of the possibilities which may result from its application to the textile industry, a course in business administration has been established to enable the student to understand and apply the principles and details of modern management. The instruction in this course begins with a consideration of the factory location and design and their effect on efficiency of production, after which the proper form of organization for manufacturing establishments is discussed in detail, together with organization charts and records.

This is followed by a study of the details of the work of the various departments, such as purchasing, manufacturing, planning, etc., and includes such topics as purchasing systems, storekeeping, perpetual inventories, warehousing, scheduling, routing, tracing, timekeeping, motion studies, time studies, mnemonic symbolizing, graphical records, wage systems, etc. Consideration is also given to the important relation of psychology to efficient management. The work is further supplemented by visits to plants where methods of production and management can be observed at first hand by the students. [Course VI.]

Elements of Accounting — B-46. Preparation: B-10 and E-30. The purpose of the course in accounting is to acquaint the student with modern methods of accounting for mercantile and manufacturing businesses. At the same time it gives him a much-needed knowledge of such common elementary business transactions as are involved in the use of checks, drafts, notes, vouchers, bonds and stocks.

It is not the purpose of the course to make the student a proficient bookkeeper or accountant, but the nature of the work necessitates a basic knowledge of double-entry bookkeeping and of the functions of ledger accounts. This is developed in practice in the following manner: During the summer preceding the fourth year the student is required to work up a simple bookkeeping set, thus saving valuable time during the school year and effectively preparing the ground for the instruction work.

The course includes a study of the balance sheet and profit and loss statement, and their construction in proper form. Attention is given to the principles of balance sheet valuation, and to such topics as depreciation in all its phases, sinking fund reserves, and the accounting for bond and stock issues. [Course VI.]

Cost Accounting — B–47. Preparation: B–46. The major portion of the time scheduled for accounting in the second term of the fourth year of the Textile Engineering course is devoted to a study of this important topic. It is designed to give the student a knowledge of the various cost methods in use at the present time, and involves a thorough discussion of methods of handling and accounting for raw materials, direct labor, and the distribution of overhead expenses. To supplement the instruction, the student is required to work up a cost accounting set. [Course VI.]

Business Law — B–48. Preparation: E–30. Under this subject are given lectures, supplemented by the use of a suitable text, on the law governing contracts, negotiable instruments, sales, bills of lading, real estate and corporation. [Course VI.]

Electives — B–49. Students in the fourth year of the Textile Engineering course will be permitted to elect certain textile subjects as substitutes for part of the time scheduled for engineering subjects. Thus a student is offered an opportunity for specialized study along such lines as will prove most beneficial to him at that time. The selection of elective studies is subject to the approval of the head of the Textile Engineering department and to the possibility of arranging for the same. [Course VI.]

CHEMISTRY AND DYEING DEPARTMENT — C

Elementary Chemistry (Inorganic and Organic Chemistry) — C–10. Preparation: Admission Requirements. Instruction in Elementary Chemistry extends through the first year, and includes lectures, recitations and a large amount of individual laboratory work on the following subjects: —

Inorganic Chemistry

Non-Metallic Elements. — Their occurrence, properties, preparation, chemical compounds, etc.

Metallic Elements. — Their occurrence, properties, metallurgy, chemical compounds, etc.

Theoretical Chemistry. — Fundamental laws and the theories of chemistry including chemical action, chemical combination, combining weights, atomic weights, chemical equations, acids, bases, salts, Avogadro's law, molecular weights, formulæ, valence, periodic law, etc.

Throughout this course special attention is given to the relationship which exists between the science of chemistry and the properties of the materials used in the various industries and the chemical reactions depended upon for the maintenance of industrial processes.

The laboratory work of this course includes the experimental study of the above subjects and also a preliminary study of the qualitative detection of the more common metals and non-metals, preparatory to Course C–12.

Organic Chemistry

This course includes a general survey of the fundamental principles of Organic Chemistry, also a study of the hydrocarbons and their derivatives from the point of view of their structure, preparation and uses. This work, although elementary in character, is of sufficient breadth to prepare the student understandingly for the general lectures upon Coal Tar dyestuffs which are given in Course C–21.

Chemistry Technology of Fibers — C–11. The outline of the lecture course which is given during the second term of the first year is as follows:—

Technology of Vegetable Fibers. — Cotton, linen, jute, hemp, china grass. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Animal Fibers. — Wool, mohair, silk. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Artificial Fibers. — Study of the various forms of artificial silk, the process of manufacture, their properties and action with chemicals, acids and heat. [All courses.]

Qualitative Analysis — C–12. Preparation: C–10 taken simultaneously. Qualitative Analysis is studied during the second term of the first year. The work consists of conferences and laboratory work. The student must become familiar with the separations and the detections of the common metals and acids by the analysis of a satisfactory number of solutions, salts, alloys and pigments. At intervals during the term short laboratory tests are given as well as the regular written examinations.

No pains are spared to make the course as valuable to the student as possible, and to encourage only thorough and intelligent work.

When sufficiently advanced, students take up the examination of various products with which the textile chemist must be familiar such as testing mordanted cloths, pigments and the various dyeing reagents.

During the latter part of this course a certain amount of time is devoted to the preliminary operations of quantitative analysis, such as the precipitation and washing of such substances as barium sulphate, magnesium ammonium phosphate and calcium oxalate, although no weighings or actual determinations are made.

A student's marks in this subject depend as much upon the neatness and care used in manipulation as upon the actual results obtained. [Course IV.]

Stoichiometry — C–13. Preparation: B–10, C–10. This subject is taken two hours each week during the second half of the first year. The application of the metric system is thoroughly studied, and problems are worked involving the expansion and contraction of gases, determination of empirical formulæ, combining volume of gases and chemical calculations, especially those of quantitative analysis. [Course IV.]

Stoichiometry — C–20. Preparation: C–13. This is a continuation of Stoichiometry C–13, and is taken during the second year as an adjunct to Quantitative Analysis. [Course IV.]

Textile Chemistry and Dyeing — C–21. Preparation: C–10, B–12, B–14.

Operations Preliminary to Dyeing. — Bleaching of cotton and linen; wool-scouring; bleaching, fulling and felting of wool; carbonizing; silk-scouring and bleaching; action of soap.

The bleaching of cotton cloth, yarn and raw stock is studied at length with detailed description of the various forms of kiers and machinery used; also the action of the chemicals used upon the material, and the various precautions that must be taken in order to insure successful work.

Under this heading is also included an exhaustive study of the reagents used in the emulsive wool-scouring process, and their action upon the fiber under various conditions; also the most successful of the solvent methods for degreasing wool.

Water and its Application in the Textile Industry. — Impurities present, methods for detection, their effect during the different operations of bleaching, scouring, dyeing and printing, and the methods used for their removal or correction.

The important subject of boiler waters is also studied under this heading, with a full discussion of the formation of boiler scale, its disastrous results, and the methods by which it may be prevented.

Mordants and Other Chemical Compounds Used in Textile Coloring and Classified as Dyestuffs. — Theory of mordants, their chemical properties and application, aluminum mordants, iron mordants, tin mordants, chromium mordants, organic mordants, tannin materials, soluble oil, fixing agents, leveling agents, assistants, and numerous other compounds, not dyestuffs, that are extensively used in the textile industry.

Under this heading are included the definitions of various terms and classes of compounds used by textile colorists, such as color lakes, pigments, fixing agents, developing agents, mordanting assistants, mordanting principles and leveling agents.

Theory of Dyeing. — A discussion of the chemical, mechanical, solution and absorption theories, and the various views that have been advanced by different investigators of the chemistry and physics of textile coloring processes.

Under this heading are discussed the general methods of classifying dyestuffs and the definitions of such terms as textile coloring, dyeing, textile printing, substantive and adjective dyestuffs, monogenetic and polygenetic dyestuffs.

Natural Organic Coloring Matters. — Properties and application of indigo, logwood, catechu or cutch, Brazil wood, cochineal, fustic, tumeric, madder, quercitron bark, Persian berries, and other natural dyestuffs that have been used within recent years by textile colorists.

Mineral Coloring Matters. — Under this heading are discussed the properties of such inorganic coloring matters and pigments as chrome yellow, orange and green, Prussian blue, manganese brown and iron buff.

Artificial Coloring Matters. — General discussion of their history, nature, source, methods of manufacture, methods of classification and their application to all fibers.

Special study of basic coloring matters, phthalic anhydride colors, including the eosins and phloxines; acid dyestuffs, Janus, direct cotton, sulphur and mordant colors, including the alizarines and other artificial coloring matter requiring metallic mordants; mordant acid and insoluble azo colors, developed on the fiber; reduction vat colors, aniline black and other artificial dyestuffs not coming under the above heads.

As each class of dyestuffs is taken up, the details of the methods of applying them upon all the different classes of fabrics and in all the different forms of dyeing machines are thoroughly discussed; also the difficulties which may arise in their application, and the methods adopted for overcoming them.

Machinery Used in Dyeing. — A certain amount of time is devoted to the description of the machinery used in various processes of textile coloring which is supplemented as far as possible by the use of charts, diagrams and lantern slides.

Most of the important types of dyeing machines are installed within the dyehouse of the school, and the students can be taken directly from the lecture room and shown the machines in actual operation. [All courses.]

Dyeing Laboratory — C–22. Preparation: C–21 taken simultaneously. Besides lectures and recitations upon the subject of Textile Chemistry and Dyeing, practical laboratory work is required. By the performance of careful and systematic experiments the student learns the nature of the various dyestuffs and mordants, their coloring properties, their action under various circumstances, and the conditions under which they give the best results. The more representative dyestuffs of each class are applied to cotton, wool and silk, and each student is obliged to enter, in an especially arranged sample book, a specimen of each of his dye trials with full particulars as to the conditions of experiment, percentage of compounds used, time, temperature of dye bath, etc.

For convenience and economy most of the dye trials are made upon small skeins or swatches of the required materials, but from time to time students are required to dye larger quantities in the full-sized dyeing machines which are described elsewhere.

By the use of a small printing machine the principles of calico printing are illustrated, and by means of the full-sized dyeing machines and vats the practical side of the subject is studied. It is the constant endeavor of those in charge to impart information of a theoretical and scientific character that will be of value in the operation of a dyehouse. [Course IV.]

Advanced Inorganic Chemistry — C–23. Preparation: C–10. The whole subject of Inorganic Chemistry is reviewed during the second year, and many advanced topics are introduced which were necessarily omitted from the first-year course in General Chemistry. [Course IV.]

Advanced Organic Chemistry — C–24. Preparation: C–10. In this course, which consists of lectures and recitations, the principles of organic substitution and synthesis are thoroughly discussed and as many illustrations are used as time will permit, particularly such as are applied in the arts. The aliphatic series of hydrocarbons and their derivatives are studied for about twenty weeks, the remainder of the time being devoted to the benzine series. The aim of the course is to lay a broad foundation for the study of the chemistry of the artificial dyestuffs. Students are required to work out problems in the synthesis of various compounds, in order to become familiarized with equation writing. [Course IV.]

Quantitative Analysis — C–25. Preparation: C–12, C–13. The object of this course is to teach the fundamental principles of quantitative analysis, and to

give the student an opportunity of acquiring skill in manipulating the special apparatus used in analytical procedure.

Typical gravimetric methods are taught the first term. The samples analyzed comprise salts, minerals and ores. Electrochemical analysis is carried out with the aid of a modern type of apparatus designed for rapid work.

The work of the second term consists of volumetric methods. A number of ores and commercial products, carefully chosen, are analyzed so as to give the student a varied experience.

The laboratory work is supplemented by lectures and recitations. Smith's "Quantitative Chemical Analysis" is used as a text. [Course IV.]

Quantitative Analysis — C–30. Preparation: C–25. The fundamental principles acquired in Course C–25 are applied in this course in the examination of materials used in the textile mill, the dyehouse, and the finishing plant. Among the materials analyzed are water, soaps, oils, textile fabrics, stripping agents, acids and alkalies. The latest and most practical methods are employed. Griffin's "Methods of Technical Analysis" is used as a text. [Course IV.]

Industrial Chemistry (Lecture) — C–31. Preparation: C–23, C–24. During the whole of the third year lectures and recitations are held in industrial chemistry, the course in general following Rogers's "Manual of Industrial Chemistry." Particular attention is paid to those subjects which are of special interest to the textile chemist, as oils, soaps, gas and coal-tar industry, building materials, and the manufacture on a large scale of important chemical compounds, such as the common acids and alkalies, bleaching powders, various mordants, etc. The course is illustrated as far as possible with specimens, diagrams and charts, and the students are given an opportunity to visit some of the industrial establishments in the vicinity of Lowell and Boston. [Course IV.]

Advanced Textile Chemistry and Dyeing — C–32. Preparation: C–21, C–22. This is a continuation of the Textile Chemistry and Dyeing course of the second year, and includes a review of the second year's work in this subject, with the introduction of many advanced considerations, and, in addition, the following subjects: —

Classification and Construction of Artificial Dyestuffs. — A study from a more advanced standpoint of the classification and constitution of artificial dyestuffs including the various methods used in their production, also the orientation of the various groups which are characteristic of these compounds and their effect on the tinctorial power of dyestuffs.

The object of this study is to give the student a more complete knowledge of the artificial dyestuffs from the color manufacturer's point of view, which will prove of particular value to those who intend later to enter the employ of dyestuff manufacturers or dealers.

Color Matching and Color Combining. — A study of that portion of physics which deals with color and the many color phenomena of interest to the textile colorist. The lecture work is supplemented with the practical application of the spectroscope and tintometer, and much practice in the matching of dyed samples of textile material.

The primary colors both of the scientist and textile colorist, the results of combining coloring lights and pigments, and such subjects as color perception, color contrast, purity of color, luminosity, hue, color blindness, dichroism, fluorescence and the effect of different kinds upon dyed fabrics, are discussed under this heading.

Each student's eyes are tested for color blindness early in the course, in order that he may be given an opportunity to change his course if his eyes should prove defective enough to interfere with his work as a textile colorist.

A dark room has been provided where various experiments in color work and color matching may be performed.

Dye Testing. — This subject includes the testing of several dyestuffs of each class, subjecting them to the common, color-destroying agencies; the determining of their characteristic properties, and their action towards the different fibers; also the determining of the actual money value and coloring power of dyestuffs in terms of a known standard.

Each student is required to make a record of each color tested upon an especially prepared card, which furnishes a permanent record of all dyestuffs, their dyeing

properties, fastness to light and weather, washing, soaping, fulling, perspiration, bleaching, steaming, ironing, rubbing, acids and alkalies.

Union Dyeing. — A study of the principles involved in the dyeing of cotton and wool, cotton and silk, and silk and wool union materials in the production of solid and two-color effects.

Textile Printing. — A thorough study of the whole subject of textile printing, each student being required to produce individually no less than twenty different prints, including the following styles; pigment style, direct printing style, steam style with tannin mordant, steam style with metallic mordant, madder or dyed style, the ingrain or developed azo style, discharge dye style, discharge mordanted style, resist style, indigo printing, aniline black printing.

The different parts of the calico printing machine are thoroughly studied; also the precautions which must be considered in its use, and the arrangement of the dyeing apparatus which must accompany such a machine.

Special attention is paid to the methods of mixing and preparing the various color printing pastes that are used in the above work upon a manufacturing scale as well as experimentally in the laboratory.

Cotton Finishing. — A study of the various processes of finishing cotton cloth and the different materials used therein. The work involves the discussion of the various objects of cotton finishing and such operations as pasting, damping, calendering, stretching, stiffening, mercerizing, beetling and filling, and the various machines used for carrying out these processes.

Mill Visits. — During the third and fourth years visits are made to some of the large dyehouses, bleacheries and print works in the vicinity. [Course IV.]

Physical Chemistry — C–33. Preparation: B–20A, B–22, C–23, C–24. Two hours of lectures and recitations per week are given during the second term of the third year and throughout the fourth year. This subject includes a study of the fundamental laws and theories of chemistry, and the application of physical measurements to chemistry with illustrative problems. Special attention is given to textile applications. [Course IV.]

Advanced Organic Chemistry — C–34. Preparation: C–24. This is a continuation of Advanced Organic Chemistry C–24. [Course IV.]

Technical German — C–35. Preparation: E–21, C–21, C–23, C–24. This course consists of the reading of German technical literature, with the object of familiarizing the student with the current German publications in textile chemistry and coloring. [Course IV.]

Organic Chemistry Laboratory — C–36. Preparation: C–21, C–23, C–24, C–25. This course, while including practice in the usual methods of organic analysis, and giving excellent training in the principles and manipulations of general organic synthesis, is especially devoted to the synthetic dyestuffs. The student not only prepares many of the representative dyestuffs, but, what is far more important, he carries out all the operations, beginning with coal tar itself. Thus, instead of merely coupling two or more of the foreign imported intermediate products to make a dyestuff, he starts with the basic substances obtained from the coal tar and makes his own intermediate products. As far as is possible the student will be made acquainted with the problems which might arise in a dyestuff factory, and an excellent opportunity is presented for original work. [Course IV.]

Technical German — C–40. Preparation: C–35. This is a continuation of Technical German C–35. [Course IV.]

Organic Chemistry Laboratory — C–41. Preparation: C–34. This is a continuation of Organic Chemistry Laboratory C–34. [Course IV.]

Engineering Chemistry — C–42. Preparation: C–23, C–24, C–25. A series of lectures is given upon the general subject of Engineering Chemistry, which includes particularly the consideration of fuels, oils and water from the chemical engineer's standpoint. The elements of chemical engineering are also considered to such an extent as time will permit. [Course IV.]

Industrial Analysis — C–43. Preparation: C–25. The lectures in Engineering Chemistry are very adequately supplemented by work in the Industrial Analysis Laboratory, which is thoroughly equipped with the latest and best apparatus for the testing of fuels, flue gases, and lubricating materials. [Course IV.]

Physical Chemistry — C–44. Preparation: C–33. This is a continuation of Physical Chemistry C–33. [Course IV.]

Advanced Textile Chemistry and Dyeing — C–45. Preparation: C–32. This is a continuation of the third-year work in Advanced Textile Chemistry and Dyeing, and includes the following subjects: —

Advanced Organic Chemistry (Dyestuffs). Advanced study of the coal-tar coloring matters, their chemistry, relations of their composition to their coloring power, and the chemistry of their preparation.

Economics of the Dyeing, Bleaching and Finishing Industries. — A study of the factors to be considered in the establishment of a dyeing, bleaching and finishing plant together with the most essential considerations of its management.

Advanced Dyeing Conference. — During the latter part of his course each student will be required to write, for presentation before the other members of his class, a paper upon some assigned subject of general interest. After presentation the subject will be open to discussion and question.

The object of this conference is twofold. First, to give the student experience and practice in systematically looking up an assigned subject and presenting it before others; and secondly, to bring before the class a greater variety of subjects with more detail than could be covered by the general lectures of the course. [Course IV.]

The Chemistry of Rayon, its Manufacture, Bleaching, Dyeing and Finishing. — During the past five years the developments of the bleaching, dyeing and finishing of rayon have been systematically studied and the curriculum of the Chemistry and Dyeing course has been revised from time to time to cover the latest developments in regard to these fibers. There is being installed at the present time a complete unit for the actual manufacture of different types of rayon, and with this available for experimental and demonstration purposes, it is anticipated that during the coming year instruction upon the production and subsequent treatment of rayon will be greatly amplified.

Many of the difficulties which arose during the early days of the artificial silk industry were due to lack of knowledge of its properties and more or less persistent attempts to handle it in just the same manner as real silk. As soon as the textile manufacturer began to fully appreciate the fact that the various rayons were entirely different fibers from true silk and consequently must be handled by different methods, then many extensive improvements were made in the processes of manufacturing textiles containing these fibers. In order to satisfactorily handle the different rayons they must receive a preliminary treatment with various oils and softeners, and as a result the problem of establishing the specifications for the best type of oil to use for this purpose and also the best methods of removing it from the material during the finishing process have been important problems in the development of the industry, and these among others are being studied in the Lowell Textile Institute at the present time.

Microscopy and Photomicroscopy — C–46. Preparation: B–22, C–21, C–23, C–24, C–25. The value of the microscope in a great variety of analytical and industrial applications related to the manufacture, processing and examination of fibrous materials cannot be overestimated. Often facts or conditions may be discovered by its use which could be arrived at in no other way.

In this course the students become acquainted with the broad field of usefulness of the microscope in physical and chemical industrial microscopy, and receive instruction in the theory and use of microscopes with their common accessories, and in industrial microscopic technique. In the laboratory the students do as much work with the instruments and accessories and in the solution of practical and typical problems as time will permit.

In conjunction with the course on microscopy and leading up to photomicrography, the students are given an excellent ground work in photography in which, by lecture and laboratory work, all of the common photographic processes are explained and performed.

With this preliminary training in microscopy and photography the students are then introduced to the difficult art of photomicrography and do as much work

therein as time will allow. Both the microscopical laboratory and the photomicrographic laboratory are well equipped. [Course IV.]

Quantitative Analysis — C–47. Preparation: C–30. This course consists of lectures, recitations and quizzes on the theory of analytical procedure and the sampling of materials. [Course IV.]

Report Writing — C–48. The purpose of this course is, in general, to enable the student to write a technical report clearly and forcibly, and specifically to assist the student in preparing a well-written thesis.

An analysis of a complete formal report is first made. This is followed by a bibliography and instructions in the use of reference books and technical magazines. The methods of obtaining data, control of variables, and the use of graphs is taught by actual practice on laboratory results. The desirability of good mechanical form is emphasized, and a short review of punctuation is included.

Throughout the course the student is required to submit many reports, formal and informal, technical and non-technical, oral and written.

Frequent reports on the progress of the student's thesis are required so that he obtains practice in the correct presentation of the original data which he has obtained and the course is completed by the preparation of a formal thesis. [Course IV.]

Thesis — C–49. Before graduation the student must present a thesis which shall consist of a report of some original investigation or research that he has conducted while at the school.

A relatively large number of hours are specially set aside for this work, and students are encouraged to select some object for their investigation which shall be of practical as well as theoretical interest. [Course IV.]

TEXTILE DESIGN AND WEAVING DEPARTMENT — D

Textile Design and Cloth Analysis — D–10. During the first year instruction is given in the subject of classification of fabrics, use of point or design paper, plain fabrics, intersection, twills and their derivation, sateen, basket and rib weaves, checks and stripes, fancy weaves, including figured and colored effects; producing chain and draw from design, and *vice versa;* extending and extracting weaves.

This subject takes up in a systematic manner the analysis of samples illustrating the various cloth constructions for the purpose of determining the design of the weave and the amount and kind of yarns used, and forms the basis of calculation in the cost of reproducing any style of goods. The various topics discussed are reeds and setts; relation and determination of counts of cotton, woolen, worsted, silk and yarns made from the great variety of vegetable fibers; grading of yarns, folded, ply, novelty and fancy yarns; application of the metric system to yarn calculation; problems involving take-up, average counts, determination of counts of yarn, and weight of yarn required to produce a given fabric. [First term, all courses.] [Second term, Courses I, II, III, VI.]

Textile Design and Cloth Analysis — D–20. For Cotton Goods — Preparation: D–10. During the second year consideration is given to fancy and reverse twills, diaper work, damasks, skip weaves, sateen fabrics with plain ground, backed fabrics, and multiple ply fabrics. Students are required to make original designs and put the same into the loom. Special attention is given to the consideration of color effect.

During the first term free hand drawing is taught by means of plates, and practice in coloring is given in conjunction with this work.

Practice in lettering, spacing and general arrangement of designs and sketches is given. The engineering alphabet is used in all work.

During the second term instruction is given in drawing, sketching, coloring and designing, with reference to their application in textiles. Good examples of applied design in textiles, as well as in other branches, are used as a basis for modified designs selected and composed by the student. This stimulates originality as well as teaches the student to appreciate good designs and color.

The analysis of these fabrics forms a part of the course in design. This also includes the necessary calculations required to reproduce the fabric or to construct fabrics of similar character. [Courses I, III, VI.]

Textile Design and Cloth Analysis — D-21. For Woolen and Worsted Goods — Preparation: D-10. During the second year the instruction given includes warp and filling backed cloth, figured effects produced by extra warp and filling, double cloths, multiple ply fabrics, cotton warps, blankets, bathrobes, crêpes, filling reversible, Bedford cords, imitation furs, crépons, matelasse and imitations, double plain, ingrains, velvets, corduroys, overcoatings, trouserings.

The analysis of these fabrics, together with the consideration of the shrinkages and dead loss in all fabrics, theory of diameter of yarns, and costs of mixer blends is a part of this course. [Courses II, III, VI.]

Textile Design and Cloth Construction — D-30. Preparation: D-20 or D-21. The advanced work takes up the more complicated weaves adapted to harness work, and leads into leno and Jacquard designs. The following is a brief list of the subject heads, which will give some idea of the course: double plain cloths, ingrains, tricots, chinchilla, tapestry, blankets, upholsteries, spot weaves, pile or plush, crépon, matelasse and its imitations, piqué, Marseilles, quilting, and miscellaneous designs for Jacquard, leno, fustian, tissue fabrics and lappets.

Original designs and sketches for particular grades of goods and the study of color effects form an important part of the third-year course. It should be understood that work in decorative art is carried on in conjunction with textile construction and weaving, particularly on the Jacquard loom. Designs of merit are carefully developed in detail and woven into cloth.

The work in cloth construction includes the application of the different weaves and their combinations in the productions of fancy designs, both modified and original; the calculation involved in the reproduction of standard fabrics changed to meet varying conditions of weight, stock, counts of yarn and value; and the discussion of the breaking strength of fabrics and relationship of the construction of the fabric to breaking strength.

Instruction in this subject, which is given by classroom work, is intended to bring together the principles considered under the subject of design, cloth construction, weaving and yarn making of previous years, and to show the bearing each has in the successful construction of a fabric. [Courses III, VI.]

Decorative Art for Special Students. — This course is planned to give a student a working knowledge and appreciation of design. The first and second years are devoted to a general study of design, color, perspective, lettering and rendering. Drawings are made in the historic styles for all materials, — wood, gold, silver, copper, brass, leather, fabrics, wall papers and glass.

In the third year students should specialize and devote their attention to the material in which they expect to work.

Power Weaving — D-22. Preparation: D-10. In connection with the work in Textile Design and Cloth Analysis practical work is carried on upon the power looms. This includes the preparation of warps, beaming, dressing, sizing, drawing-in and making of chains, the cutting and lacing of cards, spooling and quilling and the machinery for the same. A study is made of warpers and sizing machines, both for cotton and woolen. Lectures are given to correspond with the progress of the student in the Power Weaving Laboratory covering the following subjects: loom adjustments, chain building, shuttle changing looms, dobby looms, single and double acting dobbies, handkerchief motions, leno weaving, center selvedge motion, filling changing looms, oscillating reeds, lappet motions, various shaker motions, towel and other pile cloth weaving, Jacquard looms, single and double lift leno Jacquards, Jacquards of special design, tying up Jacquard harness. [Courses I, II, III, VI.]

Power Weaving — D-31. Preparation: D-20, D-21, or D-22. Instruction is given in weaving on fancy woolen and worsted looms, single and double acting dobbies, leno weaving, various shaker motions, lapper loom weaving, double and single lift Jacquard looms, tying up Jacquard harness, leno Jacquard, harness and box chain building; warp preparation for woolen and worsted and cotton; formulas for making up different kinds of sizing. Lectures are given to correspond with the same. [Courses I, II, III, VI.]

LANGUAGE AND HISTORY DEPARTMENT — E

English — E-10. Preparation: Admission Requirements. A technically trained man should be able to express himself clearly, forcibly and fluently, as inability to do so will be a serious handicap to him in after life. The object of the English course is to develop the student's power of expression by a thorough study of the principles of advanced rhetoric and composition, and by constant writing of themes illustrative of the four forms of discourse, viz., description, narration, exposition and argumentation. In addition to the study of rhetoric and composition and the writing of themes, several classics such as are not read in the preparatory schools are studied and discussed. [All courses.]

Elementary German — E-11. Preparation: Admission Requirements. This course is intended for first-year students who do not offer German as an entrance requirement and who desire to take the course in Chemistry and Textile Coloring. It may be selected by students taking the Textile Engineering course who have not fully met the entrance requirements in language. The work is elementary in character, and much time is devoted to the study of the rudiments of German grammar with practice in composition. During the latter part of the year considerable attention is given to the reading of ordinary German prose, which serves as an additional preparation to the student for the later reading of works along scientific and industrial lines.

Elementary French — E-12. Preparation: Entrance Requirements. This course is intended for first-year students who elect the Textile Engineering course and who have had two years' work in this subject. Facility in translation is acquired by a considerable amount of reading from general or scientific sources.

Advanced French — E-20. Preparation: E-12. For students who are pursuing the Textile Engineering course and offer two years' preparatory school work in French, a course in translation of scientific French is required during the second year. [Course VI.]

Advanced German — E-21. Preparation: E-11. For students who are pursuing a degree course the elementary course of the first year is continued throughout the second year. The work consists of the study of some of the more advanced principles of grammar, and especially of the reading of scientific German, dealing with a variety of subjects, and the translation of commercial German. [Courses IV, VI.]

Industrial History — E-22. Preparation: Admission Requirements. The economic history of a nation is not less interesting or dramatic than its political history, while it is absolutely essential to a thorough understanding of modern business conditions. The object of this course, which is intended for second-year students, is to trace the development of the three leading industrial nations of the world, viz., the United States, England and Germany, from simple, isolated agricultural communities to the complex, industrial and commercial society of today. The course consists of weekly lectures supplemented by textbook reading. Among the topics treated are natural resources; colonization, territorial expansion; manufactures; agriculture; finance; commerce; transportation; revenue tariffs; monopolies; governmental regulation; organization of labor; industrial legislation; immigration; conservation; contemporary problems. During the year each student will be required to write two or more theses on subjects connected with industrial history, in order that he may have practice in research work and also may continue his training in English. [All courses.]

Economics — E-30. Preparation: E-10, E-22. This course consists of lectures supplemented by recitations based upon both the lectures and a textbook. The character of the course is descriptive rather than theoretical, and the aim is to acquaint the student with the accepted principles of economics and some of their applications to industrial conditions.

Among the topics discussed are the nature and scope of economics; the evolution of economic society; the three factors of production, land, labor and capital; the four elements in distribution, rent, wages, interest and profits; business organization; value and price; monopoly; money, credit and banking; international trade; protection and free trade; transportation; insurance; economic activities of municipalities; and public finance. In short, the course deals with the fundamental principles that underlie a wide range of activities. [Courses IV, VI.]

COTTON DEPARTMENT — F

Cotton Technology of Fibers — F–10. This general course of lectures, given during the second term of the first year, covers in a broad way the manufacture of cotton into yarns. The instruction covers the classification, grading and stapling of cotton, a study of the mechanical operations in yarn manufacture, a consideration of the product and waste of each of the operations, and the uses for which various yarns are suited. [All courses.]

Yarn Manufacture — F–20. Preparation: B–10, B–12, B–14. Instruction is given by means of lecture and laboratory work. The outline of the course is as follows: —

Fiber. — Before taking up the details of the operation of manipulating the fiber into yarn, a careful study is made of the characteristics and classification, both botanically and commercially, of the many varieties of the cotton fiber. Methods employed in cultivating, marketing, grading and stapling are considered, and under these heads a detailed study is made of the types of gin employed.

Opening and Picking. — Instruction in the preliminary operation of opening and picking covers the mechanical construction of the machines, their parts and adjustments, as fully as the manufacturing results accomplished by the machines. This includes such construction details as evener, lap measuring and safety stop motion, grids, cleaning trunks, beaters, etc.; also operation details which involve the adjustment of waste, drafts and character of laps.

Carding. — The process of carding is considered one of the most important, and proper time is devoted to the construction and operation of cards, that the student may be familiar with the various parts of the card and the function and design of each. The construction and application of card clothing, as well as the methods of grinding, form a part of the work.

Combing. — This process is explained by lecture work and by operation and assembling of the various types of combs in service in the laboratory. The object of combing is fully considered, and the different means employed on the many types of combers on the market is studied. This includes such types as the Heilman, New Whitin and Nasmith combers.

Drawing. — Under this head is taken up the theory of doublings and their effect upon the quality of roving and yarn. Like previous and subsequent processes the machine construction forms an important part of the work. Proper stress is paid to such subjects as stop motions, drawing rolls and their covering, cleaners and evener motions.

Roving Processes. — Under this head are studied the various machines known as the slubber, intermediate, fine and jack fly frames. The relative motion of the various parts of these machines is so complex that a good opportunity is here presented to fix in the student's mind the application of certain mechanical principles that are used in other departments and upon other machines in the manufacture of textile material. With each process of yarn manufacture are explained the systems of sizing and numbering, and under this head are taken up both the metric and English systems. [Course I.]

Yarn Manufacturing — F–20a. Preparation: B–10, B–12, B–14. This course is similar to Course F–20, except that there is much less time devoted to laboratory work. [Courses III, VI.]

Yarn Manufacture — F–30. Preparation: F–20. Ring Spinning and Twisting. — The consideration of spinning yarn by the ring frame method involves a knowledge of the uses to which the yarn is to be put, subsequent methods of handling that proper roving may be selected, suitable amounts of draft and twist provided, correct size of rings and travelers selected, building motions suitably adjusted, etc. The operation of twisting yarns is so closely related to spinning by the ring method that it is studied at the same time. This opens an almost limitless field of novelty yarn manufacture, and offers a very good opportunity to derive new types of yarn or new mechanism to produce the effects. Yarn defects are studied with reference to the cause and remedy.

Mule Spinning. — This method of spinning is very different from that of the ring frame, and the mechanical details are more complicated. The student is furnished with new means of producing yarns and can compare the relative ad-

vantage of each method. A thorough understanding of mule spinning is perhaps more a study of mechanical motions and their functions. This results almost invariably in assisting the student to understand previous processes and machines better because of his work on the mule. It is the object to make clear to the student's mind the principles underlying the construction and operation of the parts that control the drawing, twisting, backing off, winding, together with such special motions and devices as are used upon the modern mule.

Spooling. — This subject involves a study of the various types of spoolers, spooler speeds, tensions and production.

Winding. — The different makes of winders, the packages they make, the peculiarities, special features and production of each are discussed in this work.

Reeling. — Under this topic is included the construction of the machine, the types of winding possible, the quantity of yarn in a skein, and the packing of skeins into bundles. [Course I.]

Yarn Manufacturing — F–30a. Preparation: F–20a. This course is similar to Course F–30 except that there is much less time devoted to laboratory work. [Courses III, VI.]

Knitting — F–31. Preparation: B–12, D–10. This course, commencing with a study of hosiery yarns and their preparation for knitting, includes a study of the various stitches and their application in commercial fabrics; a study of the different knitting machines, including circular and flat spring and latch needle machines used in the manufacture of stockings, sweaters and underwear; and a study of looping and sewing machines. Part of the work consists of the assembling and adjusting of different types of knitting machines.

In addition, considerable time is spent in the analysis of knitted fabrics. [Courses I, II.]

Knitting — F–31a. Preparation: B–12, D–10. This course embraces the same lectures as Course F–31 but does not include any laboratory work. [Courses III, VI.]

Cotton Organization — F–40. Preparation: F–30. Following the detailed study of the individual processes it is necessary to consider the relation of each to the other, the programs, balance of production, cost of machinery for various counts, quantities and styles of yarns. Under this heading are also studied such subjects as depreciation of machinery, cost systems, economics, arrangement of machinery, power demands, etc. [Courses I, VI.]

WOOL DEPARTMENT — G

Technology of Fibers — G–10. The principles of converting loose fibrous materials into continuous twisted strands called yarn are discussed, and the nature and uses of spindle-drawn and roller-drawn yarns explained. Particular attention is given to the nature and processing of wool, allied fibers and reworked fibers. The source of supply, original and clean cost, and the effect of tariff and exchange on fibers and processed materials from foreign countries, are illustrated by examples. [All courses.]

Top Manufacture — G–20. Preparation: B–10, B–12, B–14. Raw Materials. — A study of raw materials which enter into the manufacture of woolen or worsted yarns, or are made into yarns by processes similar to those employed in the manufacture of woolen and worsted yarns, would include silk, mohair, alpaca, vicuna, cashmere, camel's hair, cotton, flax, hemp, jute and ramie. In connection with these are considered shoddy, noils, mungo and extracts.

Wool Sorting. — Familiarity with the various grades and kinds of wool is obtained by lecture and by actual sorting of fleece wool under the direction of an experienced wool sorter. The various characteristics and properties are explained, as are also trade terms, such as picklock, XXX, XX, $\frac{1}{2}$-blood, $\frac{3}{8}$-blood, $\frac{1}{4}$-blood, delaine, braid, etc. Some skill is acquired in the estimation of shrinkage and in judging the spinning qualities.

Wool Scouring. — The object of scouring and the methods employed are explained, and this involves the consideration of the soaps and chemicals used in washing; also the waste products and their utilization. Actual work is done in scouring a commercial quantity of wool by machines that are made similar in

operation to regular commercial machines. A study is made of the effect of the hardness of water upon soap; also tests are made to show this effect. At the same time the use of dryers, their operation and regulation, is taken up, and the methods of carbonizing wool, noils, burr waste, rags, etc., are studied and practised.

Burr Picking, Mixing and Oiling. — In these processes preliminary to carding, the students have an opportunity of mixing various colors of wools to produce different effects and the influence of varying percentages of a given color in a mixture can be seen. Each student is required to make at least twenty sample mixes combining different colors and grades of stock, and to felt and mount the same. Under the subject of oils and emulsions are taken up the characteristics of various oils and the means employed to test these. The use of mixing and burr pickers is made clear.

Carding. — The different systems of carding wool, depending upon whether it is to be made into woolen or worsted yarn, are fully explained, as is also the construction, setting and operation of the cards. A part of the work is the reclothing and grinding of the cylinders, strippers, workers, etc. The carding of suitable and commercial quantities of wool, and the further manufacture of it into yarn, serves to fix the principles of carding in the mind of the student, as well as to give him some skill in handling machinery. At the completion of this part of the work he is required to prepare and hand in a full description of the process of carding, including working drawings, sketches, etc., to fully explain the machines and the methods.

Woolen Mule. — The student studies thoroughly the operation of the mule as a whole, and acquaints himself with the various principal mechanisms, as, for example, the backing off and winding motions, the quadrant, builder-rail, faller regulation, etc.

Top Making and Combing. — This branch takes up, besides the carding of the wool on a worsted card, the preparing processes, back-washing and Vigoureaux printing, also gilling of the stock before and after combing. The construction of the gill boxes and combs is studied by lectures and by dismantling and assembling these machines in the laboratories. Later, quantities of stock are made into top and then into yarn.

The Noble comb is studied, and the various calculations to determine draft, noiling, tear, productions, etc., are made. [Courses II, III, VI.]

Yarn Manufacture—G–30. Preparation: G–20. Intersecting Gill Boxes and French Comb. — The equipment of the laboratory offers opportunity for the production of dry-combed top and its comparison with oil-combed top produced on the Noble comb. The structures and uses of intersecting gill boxes and the study of combing and drawing blends is taken up at this point.

Drawing abd Spinning. — The laboratory equipment consisting of the Bradford (English) system of drawing, of both open and cone types, as well as the various processes of French drawing, followed by both worsted mule and ring spinning frame, make possible a thorough study of the manufacture of worsted yarn by all of the existing methods.

The same method of study of mechanisms, calculations, and operations of the various machines is followed as in the case of previous methods of instruction. The student by pursuing this course can compare the different methods of yarn manufacture and note the results of each.

Organization. — At the end of the course the layout of a properly balanced yarn mill is studied, and at the same time the cost of machinery, depreciation, labor costs and machinery arrangements.

Thesis. — Before graduation the student must present visible evidence of his knowledge of woolen and worsted manufacture by the production of twenty yards of fabric from his own design (or reproduction or modification of some existing fabric) beginning with the raw material.

A formal typewritten description, including all calculations and observations, together with samples from each machine, must be presented to the head of the department before the final examination. [Courses II, III, VI.]

Textile Testing — G–31. Preparation: B–22, F–30 or G–30, D–22. The object of this course is to familiarize the student with present-day methods of

Wool Combing

determining the physical properties of textile fibers, yarns and fabrics. The application of physical laws and methods of measurements, as studied in the course of Physics, is used in the study of physical characteristics of textile material. The work is given to students in advanced courses, and consists of lecture and laboratory work. Reports are prepared from each experiment, giving the object of the experiment, method of procedure, observation and conclusions, in order that the student may acquire practice and understand the interpretation of data. A special testing laboratory is provided, and a considerable number of the best standard fiber, yarn and fabric testing instruments of foreign and American make have been installed and are used for instruction in the testing of textile materials. The laboratory is equipped with means for making and keeping the humidity constant, so that tests can be made under uniform or standard conditions of humidity and temperature. [All courses.]

FINISHING DEPARTMENT — H

Woolen and Worsted Finishing — H-30. Preparation: B-12, C-10, D-10, D-22. The outline of this course, which is given by means of lecture and laboratory work, is as follows: —

Burling and Mending. — Under this head is taken up for consideration the examination of flannel as it comes from the loom; the construction, use and location of the perch; the methods used in marking defects, measuring, weighing and numbering of cloths; also the methods of inspection for fancies, single cloths and double cloths. The object of burling, mending and the types of tables employed, the method of removing knots, runners, etc., the object of back shearing and the use of burling irons, the replacing of missing threads and the importance of sewing as a part of the finishing process, are all considered in detail. The removal of oil and tar spots as well as stains of various kinds is studied.

Fulling. — This branch covers a study of the conditions of the flanel as it comes from the loom, and the influence of oil, etc., upon the procedure. Considerable time is devoted to the various methods of producing a felt, the early types of stocks, hammer falling and crank stocks, and their modifications and development into the present type of rotary fulling mills of both the single and double variety. The details of construction in all machines are carefully taken up and include the design and composition of the main rolls, methods of covering, regulation and means of adjusting the pressure of traps and rolls, consideration of the shoes, the use and regulation of the various types of stop motion, the different types of stretchers, guide rolls and throat plates.

The theory of felt is taken up and the influence of pressure, moisture, heat, alkali and acid is considered, as well as the hydroscopic and felting properties of different wool fibers. The preparation of the flannel for the mill and the usual methods of determining shrinkages, as well as the various methods of soaping, are given careful attention. The preparation of various fulling soaps and the value of each for the production of various degrees of felt as well as the determination of the proper amount of alkali for various goods, are carefully studied and demonstrated. The manipulation of the various kinds of goods in the mill, viz., all wool, shoddies and mixed goods, is studied in classroom and by operation in the mill.

The change in weight and strength for each operation is carefully considered, as is also the value of the flocks made in each. A study of the various methods of flocking, such as dry and wet, is considered in both class and machine rooms. In each operation the defects likely to materialize are studied, as well as the cause thereof, and various methods of modifying or lessening them.

Washing and Speck Dyeing. — This branch considers the scouring, rinsing and washing of goods both before and after the fulling process; the various types of washers; and the details of construction, such as suds box, rolls, etc. The theory of scouring, uses of Fuller's earth, salt solutions and scours on the different kinds of goods are made clear by practical work in the machine room, where the effects due to improper scouring, such as stains, cloudy effects, wrinkles and unclean goods, are demonstrated. The discussion of the necessity of speck dyeing follows naturally from the study of these matters, and includes methods of preparation, materials used, application and tests required.

CARBONIZING. — This is an important branch of finishing, and includes a study of the various carbonizing agents, methods of application, strength of solutions, and neutralizing, as well as the machines used. Stains and imperfections resulting from carbonizing are also considered. The drying and tentering machines and extractors employed are taken up at this point.

GIGGING, NAPPING, STEAMING, SINGEING AND CRABBING. — The construction in detail of the various types of gigs, nappers, steamers, wet gigs, rolling, stretching, crabbing, and singeing machines is discussed, and their actions upon the cloth and the results obtained are explained.

Various methods of obtaining luster and the production of permanent finish are considered in connection with steaming and sponging.

BRUSHING, SHEARING AND PRESSING. — This includes, as do the other branches, a careful treatment of the machine employed, the preparation of the cloth for each process, the action of each machine in producing its part of the resultant effect. In manipulation of the shear consideration is given to its setting, grinding and adjustment. With the brushing machine the effect of steaming and moisture upon the luster and feel of the goods is shown. A study of the action of the presses, both plate and rotary, involves consideration of pressure, steaming, etc. Special processes to obtain particular effects are taken up, and the part played by each machine is explained. The details involved in handling cloth on a commercial scale, as, for example, measuring, weighing, ticketing, numbering and rolling, are also explained. The necessary calculation and the methods of finishing all grades of goods are considered from time to time during the year. [Courses II, III, IV, VI.]

Cotton Finishing — H–31. Preparation: B–12, C–10, D–10, D–22. The outline of the course in the finishing of cotton fabrics is as follows: —

CLOTH ROOM. — Instruction of the various goods and the object thereof; construction of the various types of inspecting and trimming machines.

SHEARING. — The object. A consideration of the various types of shears for treating one or both sides at the same time; also the use of the usual cleaning devices, such as emery, sand and card rolls, beaters and brushes; grinding and the adjustment of the various parts.

The use of brushing and cleaning machines, rolling devices and calender attachments for gray goods.

SINGEING. — Developing and object of singeing; the construction of singers of all types and for various purposes; the use of cooling tanks, steaming devices, rolling and brushing attachments.

Regulation of the flame for various goods, and adjustment of the parts; gas and air pressure, water-cooled rolls; the effect of moisture on the cost of singeing and use of dry cans in connection with singeing; electric singeing.

WASHING. — Open width and string washers, their construction and operation: soaps, temperature, squeeze rolls; washing of various goods and the object thereof; stains.

NAPPING. — The object of napping and the usual method of treating goods; various types of nappers, single and double acting; felting nappers; construction, grinding and adjustments of various types.

WATER MANGLES. — Their objects and the construction of various types; various rolls, iron, husk, etc.; scutchers, their object and constructions.

STARCH MANGLES. — The object and construction of all types of starch mangles for pure starch and filled goods; various types of rolls, brass, rubber, wood; action of doctor blades, etc.; regulation and object of pressure.

Methods of starching and finishing all standard goods, also a consideration of the various substances used, such as starch, softener and fillers; the preparation of starch and various methods of application.

DRYERS AND STRETCHERS. — Both horizontal and vertical types of drying cans, tenter frames, clips, etc.; the swing motion and the finishes thus produced; object and construction of spraying machines, belt stretchers, short tenters, button breakers, etc.

CALENDERS. — The object and construction of all types, including the regulation of pressure and nips for the production of various finishes; various types of rolls and their uses, — steel, husk, cotton, paper, etc.; the use of hot and cold rolls; chasing, friction, embossing and Schreiner calenders, and the various finishes pro-

duced by each; production of watered effects; beetling machines and hydraulic mangles.

Making-up room, — yarding, inspecting; different types of folds; pressing, papering, marking. [Courses I, III, VI.]

PHYSICAL EDUCATION

All members of the freshman class are required to take a course in physical training conducted in the gymnasium under the direction of an instructor in physical education. Two periods per week for the entire first year are devoted to this work. At the beginning of the year a full record is made of the physical examinations carried on by the instructor and a reputable physician that proper and beneficial exercise may be prescribed.

The object is to give general instruction in the care and strengthening of the body, and to so guide the students that they may continue to give proper thought to their physical training that their mental development may have its greatest effect.

Proper gymnasium clothing is required and all students must take a shower bath following each exercise.

EQUIPMENT

The equipment of machinery, inventoried at $330,850.00, is most varied for textile educational purposes, and is being constantly augmented. The builders of the various machines installed keep in close touch with the Institute, adding to the machines such improvements as are made from time to time, and each year some new machine will be added by a manufacturer who finds it to his advantage to be represented here. This operates to the mutual advantage of student and manufacturer.

Cotton Yarns Department. — The opening and picking section of this department contains a 40-inch two-beater breaker lapper with automatic feeder, a 40-inch single beater intermediate and finisher lapper with Perham & Davis sectional plate evener, apron to double four laps, with an extra Kirschner patent carding beater, roving waste opener and a thread extractor, all of which have been installed by the Kitson plant of the Saco-Lowell Shops at Lowell. There is a 50-saw gin from the Daniel Pratt Gin Company, of Prattville, Alabama, besides facilities for teaching the grading and classification of cotton.

The carding, combing and drawing section contains the following machinery from the Saco-Lowell Shops: a top flat card, three revolving flat cards, two of which form a unit for waste carding, three railway heads and two drawing frames. One of these cards is equipped by the Chapman Electric Neutralizer Co., Portland, Maine, with an electric neutralizer to prevent troubles from static electricity.

The Whitin Machine Works, Whitinsville, Mass., have installed a 40-inch revolving flat card, a sliver lapper, one four-head and a six-head ribbon lapper besides a two-head, a six-head and an eight-head comber.

The H. & B. American Machine Works, of Pawtucket, R. I., are represented by the following pieces of machinery: one 40-inch revolving flat card, one two-delivery drawing frame, a roving frame, spinning frame and ring twister.

The Foster Machine Company, of Westfield, Mass., has provided two winders for making cones and multiple wound tubes.

There is a two-head comber with a model comber head made by John Hetherington & Sons, Ltd., Manchester, England.

The roving, spinning, and twisting section has the following machinery installed by the Saco-Lowell Shops, of Lowell: two slubbers, one of which is for waste spinning, an intermediate, a fine and a Jack frame, also five ring spinning frames, a spinning mule, spooler and a wet and dry twister.

The Fales & Jenks Machine Company, Pawtucket, R. I., and the Draper Corporation, of Hopedale, Mass., have each provided a wet and dry twister; the Whitin Machine Works, three spinning frames; the Woonsocket Machine and Press Company, Woonsocket, R. I., an intermediate fly frame; and the Asa Lees Company, Oldham, England, through their agents, Wm. Firth Company, a fine spinning mule.

Knitting Section. — The winders for this section include a six-spindle Universal winder for cones and tubes and a Payne bobbin winder.

The machines in the following group are equipped with special attachments for producing lace front work, high splicing, double soling and striped work. The hosiery machines include two Acme full automatic, one arranged for 160 needles and the other for 200 needles; also a Mayo Model C full automatic arranged for 220 needles. Scott & Williams have placed in this section four of their machines, Models B-5, KHH and RI. There are three Banner machines, all full automatic, two of which are arranged for 220 needles each and one arranged for 200 needles. There is one Brinton full automatic arranged for 176 needles and one Branson hand machine arranged for 80 needles. For hosiery legs and tops there are five ribbers, made by the Wildman Company, with cylinders varying from 3½–5¼ and arranged for needles varying in number from 160–240; two Brinton ribbers, one arranged for 176 needles and the other 200 needles; one Brinton tie machine, 1¾-inch cylinder 100 needles and 49 needles.

The underwear machinery consists of one Crane spring needle machine, one Scott & Williams ribber, and one Wildman ribber.

Under the group of flat machines there are three Lamb machines, one arranged for knitting gloves and one arranged for knitting sweaters. In addition to these there is also a Grosser sweater machine, a Jacquard machine, and a link and link machine; a Dubied scarf machine; and a Raschel warp knitter.

For finishing work this section includes a Grosser 2-thread looper, one Hepworth looper, two Beattie loopers; five Union special sewing machines for overseaming, double stitch covering, seaming and welting and vest finishing; six Merrow sewing machines, including two shell stitch machines and three over-seaming and crocheting machines; three Singer machines; three Wilcox & Gibbs sewing machines, including a flat lock machine.

The Philadelphia Metal Drying Form Company has installed a table of six forms including men's, women's and children's.

For instruction in the manufacture of braids the New England Butt Company has installed one 24-line Hercules braider, one 12-line braider, one tubular braider, and one soutache braider.

Wool Yarns Department. — For instruction in wool sorting and grading the room is provided and equipped with benches, baskets, etc., as well as standard samples of all grades of wool which may be used for comparison and examination.

The scouring and carbonizing equipment installed by C. G. Sargent's Sons Corporation consists of one cone duster for grease wool; four scouring bowls arranged in tandem with necessary feeds and modern carrying properties; one single apron dryer, with automatic feeder; one carbonizing screw acid tank and duster, with crush rolls. In this same department the North Chelmsford Machine Company has supplied a rinse box; Schaum & Uhlinger, one hydro-extractor; C. S. Dodge, one shoddy picker and one bagging stand.

Woolen. — In the woolen section there has been installed by the Atlas Manufacturing Company a Parkhurst burr picker. The Davis & Furber Machine Company has installed a mixing picker equipped with improved mixing picker feed and Spencer oiler, both made by George S. Harwood & Son, Boston, Mass. There are three sets of woolen cards furnished by Davis & Furber Machine Company which are equipped with Bramwell feed furnished by George S. Harwood & Son. One of the sets has the first and second breaker cards coupled. All have apron condensers on the finishers. There is a sample mixing card furnished by the Torrance Manufacturing Company which offers an opportunity for carrying on experiments and mixing various kinds and colors of wool. There are two spinning mules, 120 spindles each, one furnished by the Davis & Furber Machine Company of North Andover and equipped with bobbin holders supplied by the American Bobbin Holder Company, West Medway, Mass., and the other furnished by Johnson & Bassett, Worcester, Mass. In addition to these two mules each company has supplied for the purpose of instruction a spinning mule head mounted on movable platform to facilitate class instruction. Besides these mules the Davis & Furber Machine Company has supplied a fancy yarn twister, 20 spindles; the Lindsay Hyde Company modern skein winder. For card grinding the B. S. Roy & Son Company of Worcester, Mass., has supplied one grinding frame and two

traverse grinders; T. C. Entwistle Company, Lowell, Mass., one traverse grinder; W. H. Brown, Worcester, Mass., one complete set of carder's tools.

Worsted. — In the worsted section the Davis & Furber Machine Company has furnished one double-cylinder worsted card (4 licker-in) with Bramwell feed. On this card as well as one in the woolen section the Chapman Electric Neutralizer Company has supplied one of its patented electric neutralizers. This section also includes a double bowl, 5-cylinder back-washer, with gill box, Taylor-Wordsworth & Co., Leeds, Eng., equipped with blueing motion, oiling motion, and Layland patent pressure motion; a weigh gill box and creel and one doubling balling head gill box (with double screws) made by the Saco-Lowell Shops of Lowell, Mass.; a worsted comb with baller punch made by Crompton & Knowles, Worcester, Mass.; two finishing gill boxes, one known as a can gill box and the other a balling head gill box, both made by Hall & Stell, Keighley, Eng.

For the manufacture of yarns under the Bradford System of Drawing, Spinning and Twisting, the following machinery as made by Prince Smith & Son, Keighley, Eng., make up the equipment: one revolving creel for 12 balls, one 2-spindle drawing box, one 4-spindle first finisher, one 12-spindle dandy reducer, one 12-spindle cap spinner, one double head can gill box, one 2-spindle gill box, one 2-spindle flyer spinner, one 12-spindle ring spinner, one 12-spindle 2-fold cap twister, one 12-spindle 6-fold ring twister. In addition to this the Saco-Lowell Shops, Lowell, Mass., have installed the following machinery to carry on similar work; one 2-spindle drawing box, one 6-spindle second finisher, one 24-spindle dandy rover, one 6-spindle cone reducer, one 8-spindle cone rover, one 48-spindle cap spinner, 5-foot end, one 48-spindle cap spinner, 4-foot end, one 48-spindle Boy ring twister. For conditioning yarn C. G. Sargent's Sons Corporation has supplied one of its conditioning machines. The Universal Winding Company has installed one of its 6-gang winders, equipped for cones or straight tubes.

The humidity in the laboratory of the woolen yarns and of the English system of worsted yarns is maintained by the American Moistening Company's system through its automatic control. In this laboratory are installed six humidifiers and four Comins's High Duty heads, which are supplied from an electric-driven triplex power pump located in the power house. This same pumping equipment supplies the American Moistening Company's humidifiers operating in the Cotton Yarn Department.

For the manufacture of worsted yarns under the French System of Drawing and Spinning the machinery has been made by the Société Alsacienne de Constructions Mechaniques, Mulhouse, France, and the equipment consists of the following: Model P. L. B. comb with creel for 24 doublings, intersecting gill box (2 heads), gill box (2 heads), first drawing (2 heads), second drawing (2 heads), third drawing (2 heads), reducer (4 porcupines), slubber (8 porcupines), first intermediate (8 porcupines), second intermediate (8 porcupines), rover (8 porcupines), finisher (16 porcupines), self-acting worsted mule (150 spindles).

The Saco-Lowell Shops built and installed a ring spinning frame of 60 spindles for worsted yarns equipped with individual General Electric Company's motor and a Reeves Variable Speed Transmission.

Twelve turbo humidifier heads automatically controlled by a humidity regulator have been furnished by the G. M. Parks Company, Fitchburg, Mass. The compressed air for these heads is supplied by an Ingersoll-Rand 8 by 8 steam-driven air compressor.

For the purpose of determining the physical properties of fibers, yarns, and fabrics there has been installed a Textile Testing Laboratory where there are the necessary microscopes and micrometers, a skein-testing machine, and electric conditioning oven made by the Emerson Apparatus Company of Boston; single yarn and fabric strength-testing machines made by G. R. Smith & Company, Bradford, Eng.; a strength-testing machine, capacity 500 kilograms, for testing twines and fabrics; a fiber-testing machine for testing fibers and fine yarns with capacity, 1 gram to 1.5 kilograms; a yarn strength-testing machine with capacity 1,000 to 5,000 grams; and a yarn strength testing machine with capacity 5 to 30 kilograms, all of which have been made by Louis Schopper, Leipzig, Germany. Besides these we have a standard yarn and fabric testing machine as made by Henry L. Scott & Company of Providence, R. I., and a Mullen Tester. For the automatic con-

trol of temperature and humidity there has been installed by the American Moistening Company, of Boston, one of its automatic humidity and temperature regulators.

Design and Power Weaving Department. — In the fabric analysis section there has been provided chemical balances made by Voland & Sons and Christian Becker, necessary twist testers, microscopes, reels, etc., as well as a Torsion calculation balance made by the Torsion Balance Company of New York.

In the warp preparation department there has been installed by the Saco-Lowell Shops one of its spoolers, besides a warper and a slasher for preparing cotton warps; a beamer by T. C. Entwistle Company of Lowell, a 400-end improved Draper warper furnished by the Draper Corporation of Hopedale, Mass. The Whitin Machine Company, Whitinsville, Mass., has supplied a 180-spindle, long-chain quiller, and the Johnson & Bassett Company, Worcester, Mass., a quiller of its make. The Universal Winder Company has supplied a winder for copy and bobbin winding and an 8-spindle doubler.

The woolen and worsted warp preparation department contains two 40-end Jack spoolers, two spool racks for 12 spools each, one pattern dry frame dresser, one pipe and cylinder dresser, one 60-inch reel, one 82-inch reel, and one double head beamer, all supplied by the Davis & Furber Machine Company of North Andover, Mass.

The Weaving Department contains four looms supplied by the Draper Corporation of Hopedale, Mass., which include a plain Northrup, an 8-harness corduroy, an improved Northrup, a Northrup with dobby. The Stafford Loom Company of Readville, Mass., has installed one plain, one cam, one dobby loom and one broad sheeting loom, all equipped with individual motors; the Whitin Machine Works, Whitinsville, Mass., a side cam twill, a plain print cloth loom, equipped with Kip-Armstrong electric warp stop motion; the Kilburn & Lincoln a plain loom; Lewiston Machine Company a 4-harness side cam and a bag loom; Crompton & Knowles Loom Works a jean loom and a plain loom with individual drive. Four of these looms are equipped with Abbott cleavers made by the Abbott Wire and Cast Steel Warp Cleaving Company, Lisbon Falls, Maine. The Hopedale Manufacturing Company of Milford, Mass., has recently installed one of its high speed looms with individual motor.

The fancy loom section includes a Stafford Ideal 16-harness automatic shuttle-changing loom, a Whitin 20-harness dobby loom, and the following furnished by the Crompton & Knowles Loom Works: Knowles gingham 4 by 1 boxes, Crompton gingham 4 by 1 boxes, one Crompton towel 2 by 1 boxes, two Terry towel and one huck towel looms, a 16-harness lappet loom, a 20-harness dobby 4 by 1 boxes, fancy leno loom, and a Crompton fancy cotton single cylinder 20-harness dobby.

The woolen and worsted section contains a Knowles 20-harness Gem, a Crompton 24-harness worsted 4 by 4 boxes, a Crompton 6 by 1 double cylinder 20-harness dobby, one heavy 20-harness 4 by 4 boxes, one 20-harness and one 25-harness blanket, seven intermediate woolen 25-harness 4 by 4 boxes and two 90-inch 25-harness heavy woolen looms.

The Jacquard loom section includes one Stafford silk loom, 1,200-hook, Halton head; one 400-hook, single-lift, Schaum & Uhlinger Jacquard, mounted for 4-bank, narrow fabric loom; one Felix Tonnar German plush loom, with 400-hook Crompton & Knowles Jacquard head; one Skinner Brussels carpet loom, three-quarters wide, equipped with 1,280-hook Jacquard head presented by the Bigelow-Hartford Carpet Company, Clinton, Mass. The Crompton & Knowles Loom Works has furnished one Knowles fancy loom, single-lift Jacquard; one Knowles fancy loom, double-lift Jacquard; one Knowles fancy loom, Jacquard tied up for leno, one Knowles ingrain carpet loom, 4 by 4 boxes, one Knowles loom, 4 by 4 boxes, 54-inch, with 600-hook, double-lift, double-cylinder McMurdo Jacquard head, tied up for damask napkin designs, one Crompton ingrain carpet loom, 4 by 4 boxes, one Crompton & Knowles 72-inch tapestry loom, with 2,600-hook Halton Jacquard head, one 840-hook, double-lift, single-cylinder Jacquard on Crompton & Knowles 4-bank ribbon loom, one 800-hook, double-lift Knowles Gem silk brocade Jacquard machine, 4 by 4 boxes.

For the purpose of card cutting there has been furnished one Jacquard fine index card-cutting machine by John Royle & Sons, Paterson, N. J.; one Jacquard

French index card-cutting machine by the same concern, and one Jacquard French index card-cutting machine presented by the Bigelow-Hartford Carpet Company, Lowell, Mass.

Chemistry and Dyeing Department. — The Chemistry Laboratory consists of one to give instruction in General Chemistry and Qualitative Analysis and provides facilities to take 120 students. The Quantitative Laboratory takes care of some 50 students and contains the necessary drying closet, steam bath, electrolytic table, with ample facilities to provide distilled water through the use of a Barnstead Water Still. The Balance Room, which is adjacent to the laboratory, has eleven analytical balances made by such concerns as Christian Becker, Eimer & Amend, and H. L. Becker's Sons & Company. The Organic Laboratory has facilities to take care of approximately 25 students having the necessary equipment required in the preparation of basic organic compounds and instruments used in the manufacture of dyes such as autoclaves, electric and gas combustion furnaces.

For the purpose of carrying on photographic and microscopic experiments and analyses the laboratory has been provided with equipment which includes besides the Bausch & Lomb microscopes, a polariscope made by Franz Schmidt & Haensch, Berlin, Germany, a Gaestner spectroscope, a Bausch & Lomb Model G photomicrographic apparatus equipped with D. D. S. microscope and all necessary apparatus, a Kodak projection printer. In the dark room there has been placed a piece of apparatus for determining the relative fading powers of various light sources. Besides the common gas and electric lamps there is installed a solar determinator, made by the Atlas Electric Company, Chicago, Ill., also a 400-watt Nela Trutint and color-matching unit made by Nela Specialties Division, Cleveland, Ohio.

The Chemical Museum has been provided with cases and representative dyestuffs all furnished by various dyestuff manufacturers of this country and abroad. This offers an unparalleled opportunity for students to study and experiment with almost all of the representative dyes which are used in the textile industry.

The Experimental Dyeing Laboratory is equipped with individual benches, small dyeing apparatus, reels, balances, apparatus for dye testing, such as frames for exposing dyed material to light, and a complete collection of dyestuff samples and sample cards. There are also fifty-six steam coil experimental dyeing baths, a drying chamber and ageing chamber, in addition to a Hurricane Dryer, Class D, made by the Philadelphia Drying Machinery Company, Pennsylvania. Adjacent to the Experimental Dyeing Laboratory there has been provided a well-lighted room for the storage of a great variety of dyestuffs. Steel shelving has been arranged so that the samples are easy of access. All samples are catalogued in a card file, thus facilitating their use.

The Experimental Printing Laboratory is equipped with a calico printing machine, made by Mather & Platt, Manchester, Eng., an iron-jacketed steaming chamber from A. Edmeston & Son, Patricroft, Eng., and a set of steam-jacketed copper kettles.

The Fuel and Oil Analysis Laboratory contains the following equipment for the analysis of coals and fuels: a Mather bomb calorimeter, with complete outfit, an Emerson bomb calorimeter, with complete outfit, a Parr calorimeter, an Abbe refractometer, a Torsion viscosimeter, a Tagliabue viscosimeter, a Tagliabue cold test apparatus, a Pensky Martin oil tester, a New York State oil tester, a Sartorius specific gravity balance, two Becker analytical balances, gas muffle furnace, Kny-Scherer oil tester, a Graefe gas calorimeter, an Orsat gas analysis apparatus, laboratory tables, lockers, and hoods.

The Industrial Chemistry Laboratory contains the following: one filter press, Type E. T. Shriver & Company; a single-acting triplex plunger pump, Goulds Manufacturing Company; a vacuum drying apparatus, a surface condenser, a Packard vacuum pump, Norman Hubbard's Sons; a vacuum evaporator, Swenson system, American Foundry and Machine Company; a centrifugal, C. H. Chavant & Company; a double jar mill, F. I. Stokes & Company.

To give instruction in dyeing on a basis which is more comparable with commercial practice there is provided a laboratory which includes the following equipment: a small kier, fitted with E. D. Jefferson's circulating device, an electrolyzer

for manufacturing bleaching solutions, the National Laundry Machine Company, Dayton, Ohio; a Permutit filter, the Permutit Company, New York City; a mercerizing machine, a raw stock dyeing machine, Klauder-Weldon Dyeing Machine Company, Yardley, Pa.; a yarn dyeing machine, Klauder-Weldon Dyeing Machine Company; a jig dyeing machine, the Textile-Finishing Machine Company, Providence, R. I.; a set of drying cans by the same concern; a chain dyeing machine, T. C. Entwistle Company, Lowell, Mass.; a raw stock drying table, Proctor & Schwartz, Philadelphia, Pa.; a padding mangle, Arlington Machine Works, Arlington, Mass.; a hydro-extractor, W. H. Tolhurst & Son, Troy, N. Y.; a Psarski experimental dyeing machine, a Hussong experimental dyeing machine, equipped for raw stock or yarns, a Rodney Hunt sample piece dyeing machine, equipped with an automatic temperature and pressure-regulating apparatus, made by C. J. Tagliabue Manufacturing Company, Brooklyn, N. Y. The Franklin Process Company, Providence, R. I., have furnished a 25-pound bronze dyeing machine. Of the various dye tubs, one is equipped with a Monel Metal lining to withstand the action of various chemicals and dyes.

Finishing Department. — The Woolen and Worsted section includes a 4-string washer, a fulling mill, and a combination fulling and washing mill for jersey fabrics, furnished by the Rodney Hunt Company, Orange, Mass.; a sample fulling mill, a kicker mill, furnished by James Hunter & Company, North Adams, Mass.; an up and down dry gig, a rolling and stretching machine, an up and down wet gig, a steam finishing machine, a 60-inch, 3-burner singeing machine, adapted for cotton, silk or worsted goods, a 2-cylinder double-acting brushing machine, a 60-inch, 4-cylinder sanding and polishing machine, furnished by Curtis & Marble Machine Company, Worcester, Mass.; a 66½-inch motor driven, single woolen shear, equipped with list saving motion, donated by Curtis & Marble Machine Company; a 6/4 double shear, an A. W. C. measuring and weighing machine, furnished by Parks & Woolson, Springfield, Vt.; a dewing machine, a 6/4 Voelker rotary press, furnished by G. W. Voelker & Co., Woonsocket, R. I.; a tentering and drying machine furnished by John Heathcote, Providence, R. I., a single crabbing machine, H. W. Butterworth & Son, Philadelphia, Pa.; a 72-inch woolen napper donated by Davis & Furber, North Andover, Mass.; a 32-inch basket hydro-extractor, W. H. Tolhurst, Troy, N. Y.; a Lintz & Eckhardt cloth numbering machine, from Durbrow & Hearne Company, New York; a steam press for underwear, United States Hoffman Company, Syracuse, N. Y.; a sewing machine, Birch Brothers, Somerville, Mass.; a trimming and overseaming machine, The Merrow Machine Company, Hartford, Conn.

The Cotton section includes a 40-inch inspecting and brushing machine, a 44-inch No. 25 railway sewing and rolling machine, a 44-inch cotton shearing machine, Type No. 34, a 44-inch No. 3 steam calender rolling machine, a 40-inch cloth folder, a 40-inch winder and measurer, a set of 44-inch shear blades for grinding purposes, furnished by Curtis & Marble Machine Company, Worcester, Mass.; a 48-inch No. 4 opening, sewing and rolling machine, a No. 1 hand power portable railway sewing machine, furnished by Dinsmore Manufacturing Company, Salem, Mass.; a 40-inch 4-tank open soaping machine equipped with patent flushing rolls, brass and rubber squeeze rolls and spiral openers, furnished by Birch Brothers, Somerville, Mass.; an 84-inch 36-roll, ball bearing, double acting napper, equipped with a 7½-horsepower General Electric motor drive, furnished by Davis & Furber, North Andover, Mass. (the ball bearings were donated by the Fafnir Bearing Company, New Britain, Conn.); an 8-inch belt lacer furnished by the Clipper Belt Lacer Company of Grand Rapids, Mich.; a 40-inch, 3-roll water mangle, with husk and brass rolls and usual attachments and equipped with a 48-inch Mycock scutcher, and a 40-inch Mycock cloth expander made by Thomas Leyland & Company, Boston; a 40-inch, 2-roll starch mangle, a 40-inch upright drying machine with 10 copper cylinders equipped with Files dry can system, Files Engineering Company, Inc., Bridgeport, Conn.; a 40-inch sprinkler, a 40-inch, 5-roll Universal calender with chasing attachment and equipped with a 40-inch Mycock cloth expander, a pasting table with plate, furnished by the Textile-Finishing Machinery Company, Providence, R. I.; a 16 by 24 inch bronze-covered stretcher for the drying cans, C. A. Luther & Company, Providence, R. I.; a 40-inch double bristle stretcher for drying cans, American Finishing Machinery Company, Boston, Mass.;

a trimming and overseaming machine, The Merrow Machine Company, Hartford, Conn.; a 40-inch Tommy Dodd starch mangle, and a 44-inch, 50-foot vibratory tentering machine, H. W. Butterworth & Sons Company, Philadelphia, Pa. This machine is directly driven by a 7½-horsepower variable speed motor and is equipped with a Schwartz automatic electric guider, made by L. H. A. Schwartz & Company, Boston, Mass.

Engineering Department. — The Steam Engineering Laboratory contains the following equipment arranged for experimental purposes: A 50-horsepower Allis-Chalmers Corliss steam engine direct connected to an Alden absorption dynamometer, and piped to exhaust its steam to the atmosphere, to a Wheeler surface condenser or to the Kerr turbine; a Kerr seven-stage turbine driving directly a 25-kilowatt Richmond Electric Company's alternating current generator and piped to exhaust either to the atmosphere or the condenser. It may be operated either as high pressure or low pressure turbine, and the generator has special connections to illustrate various commercial phases. In addition there are a 4 by 6 Deane triplex power pump, two 2-inch centrifugal pumps made by Lawrence Machine Company, Lawrence, Mass., a Clayton air compressor and necessary tanks, scales and measuring instruments. For the measurement of flow of air there are a steam-driven Sturtevant fan and a motor-driven Massachusetts fan with heater combined for heating and drying experiments.

The Electrical Engineering Laboratory consists of two sections, one of which is devoted to instruction in the generation and transmission of power, and contains the necessary switchboard and instruments to control a 25-kilowatt alternating current turbo generator and a 15-kilowatt motor generator set arranged to supply either direct or alternating current. In addition there are a 24-horsepower direct current Allis-Chalmers motor and a 10-horsepower direct current General Electric motor, also a 10 and a 7.5 horsepower General Electric alternating current motor besides a General Electric 3-kilowatt rotary transformer and three Westinghouse stationary transformers. The other section of the laboratory is known as the instrument laboratory and is for the purpose of giving instruction in the measurement of current voltage, resistance, and in the calibration of instruments. It contains a 5-kilowatt Crocker-Wheeler balancer, a 160-ampere hour storage battery, a 5-kilowatt 220-volt to 440-volt General Electric transformer, a Westinghouse portable wattmeter with current and potential transformers, three wattmeters, two ammeters and a voltmeter, all of the General Electric portable alternating current type, a 30-volt alternating current Roller Smith voltmeter, a 5 to 10-scale Weston ammeter (electro-dynamometer type), a Weston millivoltmeter with 2, 20, 50 and 200 ampere shunts, three 250-volt direct current Weston voltmeters, a 150-ampere, two model, 45 two model 260 Weston portable ammeters, a Weston model 260 voltmeter, a Thompson 50-ampere recording wattmeter, a General Electric rotating standard wattmeter, two General Electric induction type watt hour meters, an Esterline portable curve drawing wattmeter, a 100-ampere Leeds & Northrup Standard Resistance, a Leeds & Northrup Ayrton shunt, a Weston laboratory standard voltmeter with 600-volt multiplier, a Leeds & Northrup potentiometer, a D'Arsonval wall type galvanometer, a Wheatstone bridge with galvanometer, a slide wire bridge and electro-dynamometer, Weston Standard cell, potential phase shifter, a standard Leeds & Northrup photometer with Lummer-Brodhun screen, and Macbeth illuminometer made by the same concern.

Machine Shop. — The equipment of the machine shop is as follows: Four standard engine lathes, 13-inch swing, 6-foot bed, from Flather & Company, Nashua, N. H.; three standard engine lathes, 14-inch swing, 6-foot bed, from Flather & Company, Nashua, N. H.; a standard engine lathe, 15-inch swing, 6-foot bed, from F. E. Reed Company, Worcester, Mass.; an engine lathe, 18-inch swing, 10-foot bed, from Flather & Company, Nashua, N. H.; an engine lathe, 18-inch swing, 6-foot bed, from Champion Tool Works, Cincinnati, Ohio; a standard engine lathe, 15-inch swing, 6-foot bed, from S. H. Putnam Sons, Fitchburg, Mass.; five speed lathes, 17-inch swing, 5-foot bed, from J. G. Blount, Everett, Mass.; one No. 1 Universal milling machine, with all three feeds automatic, from Kempsmith Manufacturing Company, Milwaukee, Wis.; one 24 by 24 inch, 6-foot planer, from the Mark Flather Planer Company, Nashua, N. H.; one 23-inch upright drill, with back gears and power feed, from J. E. Snyder & Son, Worcester, Mass.; one

14-inch single sensitive drill, from the Stanley Manufacturing Company, Lawrence, Mass.; one No. 1 Universal grinder, from Landis Tool Company, Waynesboro, Pa.; one 20-inch wet tool grinder, from J. G. Blount, Everett, Mass.; one 12-inch, 2-wheel dry grinder, from J. G. Blount, Everett, Mass.; an American twist drill grinder, from the Heald Machine Company, Worcester, Mass.; one Type 1B portable electric grinder from the Cincinnati Electric Tool Company, Cincinnati, Ohio; one 30-inch grindstone and frame, from the Athol Machine Company, Athol, Mass.; a single spindle centering machine, from D. E. Whiton Machine Company, New London, Conn.; one 15-inch shaper, from Potter & Johnson, Pawtucket, R. I.; one power hacksaw, from the Fairbanks Company, Boston, Mass.; one cold saw, from John T. Burr & Son, Brooklyn, N. Y.; one Eureka metal power saw, Manning, Maxwell & Moore; one Type CC electric drill, Cincinnati Electric Tool Company; one Universal milling attachment for Kempsmith milling machine, Taylor Machinery Company; one Hisey Type B ½-horsepower tool post grinder, Taylor Machinery Company; one No. 2 Cory bench straightener, Manning, Maxwell & Moore; one No. 3 Universal cutter and reamer grinding machine, Browne & Sharpe; a well-equipped tool room containing a selected stock of the best makes of small tools, such as drills, taps and dies, milling cutters, reamers, gauges, micrometers, etc.

Power, Light, Heat and Ventilating Plant. — In the powerhouse there is located the main power-generating apparatus for supplying light, heat and power to all departments of the Institute. The equipment here consists of: two 250-horsepower Heine water tube boilers, equipped with Perfection grates, a 300-horsepower Aultman & Taylor horizontal water tube boiler, equipped with United States rocking grates, two boiler feed pumps — one a Knowles and the other a Deane — a 40,000-pound Cochrane metering open-feed heater, which is provided with a Lea recorder, and a Cochrane oil extractor heats and measures all feed water, a 3-inch Venturi meter in feed line with indicating manometer as made by the Builders Iron Foundry, Providence, R. I. In the Engine Room are located: a Payne 14 by 14 automatic high speed engine, 125-horsepower direct connected to 75-kilowatt, 220-volt, direct-current Bullock generator, a 9½ by 11 Nash gas engine of 50-horsepower, 4-cycle type, with speed-regulating clutch and a "hit and miss" governor, direct connected to a 30-kilowatt, 220-volt, direct-current Bullock generator, a 65-kilowatt motor generator set, consisting of a direct current motor and an alternating current generator. This unit may be run either A. C. to D. C. or D. C. to A. C., and was made by the Westinghouse Electric and Manufacturing Company. A steam-driven Ingersoll-Rand 8 by 8 air compressor, for use with Turbo heads, installed in the French Spinning Department by the G. M. Parks Company, Fitchburg, Mass., a 5½ to 6 motor-driven air compressor, with 20 cubic foot storage tank for use in starting Nash gas engine, a Cross oil filter. The station switchboard is of marine-finished slate, 90 inches in height, and consists of three generator panels and two circuit panels.

The powerhouse is connected with the main school buildings by a tunnel through which all wires, steam and water pipes are carried. The steam pipes supply heat to the buildings by means of direct radiation, and by means of the Sturtevant double duct heating and ventilating system located in the basement of Southwick Hall, and by the Sturtevant fan and heater located in the basement of Kitson Hall. Direct-driven exhaust fans are placed on the roof of Southwick Hall and in the basement laboratories.

GRADUATES, JUNE 19, 1928

Graduates, with Titles of Theses

Bachelor of Textile Chemistry

Robert Burns, Easthampton, Mass. "The application of vat dyestuffs to wool and silk."

James Francis Corbett, Dracut, Mass. "A study of wool, oils and emulsions." (Thesis with John F. Fitzgerald.)

William Francis Dolan, Lowell, Mass. "A study of the dyeing peculiarities of reduction vat dyes of the anthraquinone type."

Paul Leon Fasig, Reading, Pa. "The concentration and control of the rayon settling bath."

John Francis Fitzgerald, Lawrence, Mass. Thesis with James F. Corbett.

Stephen Kenneth Ford, Haverhill, Mass. "Some derivatives of orthocresotinic anilide."

John Vincent Killheffer, North Caldwell, N. J. "The prevention of mildew in cotton goods."

Benedict Josephus McKay, Stoughton, Mass. "A scientific study of the different sizing materials on cotton in respect to their advantages and disadvantages in the various methods of application."

Harold Hrant Parigian, Hudson, Mass. "Possible substitution of organic dyestuffs, for mineral oxides, used for coloring cement, either used to color cement directly in the mixing or coloring it superficially."

Francis Rudolph Rodalvicz, Anthony, R. I. "A study of the isomers of para cresotinic anilide and certain derivatives of them."

Clifford William Sampson, Plymouth, Mass. "The effect of chlorine bleaching solutions on dyed cotton in conjunction with white (or grey) cotton."

John Francis Shea, Fitchburg, Mass. "The tendering of cotton cloth by the action of sodium hypochlorite."

Elias Aaron Tarshis, Springfield, Mass. "The methods of analysis and composition of commercial rayon lubricants."

George Chester Ward, Andover, Mass. "A comparison of the various methods of determining the reducing power of hydrosulphites and sulphoxylates."

E. Maybelle Warren, Billerica, Mass. "Temperature control of acid dyeing with relation to critical temperatures."

Bachelor of Textile Engineering

Clifford Albert Farley, Lowell, Mass. "A study of the method of determining uniformity of yarns by means of frequency series."

Lawrence William Gottschalck, Gloversville, N. Y. "A study of the tension in worsted yarns during cap spinning."

George Leslie Logan, South Portland, Maine. "A study of the effect of twist upon the properties of artificial silk yarns." (Thesis with George G. Osborne.)

Edward Perkins McGuire, Chestnut Hill, Mass. "The effect of a varying number of drawing processes upon the strength, elasticity, and evenness of a cotton hosiery yarn."

Raymond Wellington McKittrick, Lowell, Mass. "A study of finishes of cotton fabrics by the use of light." (Thesis with William S. Russell, Jr.)

George Gordon Osborne, Montreal, Can. Thesis with George L. Logan.

Kurt Herman Reinhold, Clifton, N. J. "A determination of the effect of regain upon the strength and elasticity of woolen and worsted fabrics."

William Samuel Russell, Jr., Haverhill, Mass. Thesis with Raymond W. McKittrick.

Alvin Briggs Storey, Belding, Mich. "A comparative study of the properties of yarns made by two long-draft spinning systems and by ordinary commercial drafts."

John Chester Westaway, Hamilton, Ont. Thesis with Alvin B. Storey.

Edward Lawrence Wingate, Jr., Malden, Mass. "A comparative study of the influence on worsted yarns and fabric of the omission of certain operations in the Bradford system of combing (Noble) and drawing."

Kenneth Leroy Woodbury, Bradford, Mass. "An investigation of the possibility of using an illuminometer to determine the differences in the finishes of cotton fabrics." (Presented in June, 1927, with Mr. L. W. Guild, co-author.)

Diploma Graduates

Cotton Manufacture

John Harold Swanson, Griffin, Ga. "The manufacture of a Terry towel."

Francis Putney Wetherbee, Albany, Ga. "The effect of drawing on the strength, elongation, and uniformity of a carded cotton yarn."

Wool Manufacture

Thomas Francis Connor, Boston, Mass. "The manufacture of a woolen suiting."

Avard Nelson Darby, Billerica, Mass. "The manufacture of a woolen overcoating."

Arthur Leon Ferris, Port Rowan, Ont. "The manufacture of a woolen suiting."

Wolfred Hyman, Roxbury, Mass. "The manufacture of a woolen suiting."

Harold Wheeler Joslin, Milford, N. H., "The manufacture of a woolen overcoating."

James Joseph Maguire, North Attleboro, Mass. "The manufacture of a woolen suiting."

Textile Design

Harold Conrad Bauer, Lawrence, Mass. "The manufacture of a worsted suiting."

John Bottomley, North Andover, Mass. "The manufacture of a worsted suiting."

Daniel Joseph Coffey, Pittsfield, Mass. "The manufacture of a worsted suiting."

Sydney Davidson, Roxbury, Mass. "The manufacture of a worsted suiting."

Maxwell Pearlstein, Boston, Mass. "The manufacture of a worsted suiting."

Jackson Ambrose Shedd, Nabnassett, Mass. "The manufacture of a worsted suiting."

John Smith Stott, North Andover, Mass. "The manufacture of a worsted suiting."

Kenneth Edward Strout, South Portland, Maine. "The manufacture of a worsted suiting."

Prizes awarded in June, 1928

Textile Colorist Award of $100 offered to a member of the graduating class whose thesis, based upon his personal researches and experiences, is of the greatest practical value to the dyeing, bleaching, or textile finishing industries. To *John Vincent Killheffer.*

The Medal of the National Association of Cotton Manufacturers awarded to the student taking course in Cotton who maintains the highest average in scholarship throughout this course. To *George Gordon Osborne.*

Edward A. Bigelow Prize of $100 to the member of the graduating class from the Wool Manufacturing course who maintains the highest standing throughout his three years. To *Wolfred Hyman.*

Edward A. Bigelow Prize of $50 to the member of the second-year class in the Wool Manufacturing course who maintains the highest standing during his second year. To *Joseph Johnson Brook.*

Louis A. Olney Prizes (in the form of books).

$20 to the regular student in the Chemistry and Textile Coloring course who shall present the best thesis preparatory to graduation. To *Clifford William Sampson.*

$10 to the regular student of the Chemistry and Textile Coloring course who shall be considered as having attained the highest scholarship during his second year. To *Morris Barsky.*

$5 to the regular student of the Chemistry and Textile Coloring course who shall be considered as having attained the second highest scholarship during his second year. To *Arthur Francis Gallagher.* Honorable Mention, *Willard Alvah Colby, Jr.*, and *Alfred John Carbone.*

$10 to the student taking the regular Chemistry and Textile Coloring course who shall be considered as having attained the highest scholarship in first-year Chemistry. To *Norman Albin Johnson.*

$5 to the student taking the regular Chemistry and Textile Coloring course who shall be considered as having attained the second highest scholarship in first-year Chemistry. To *Abraham Lifland.* Honorable Mention, *Richard Lea Brook* and *Stanley Arundel Hall.*

Herbert A. Currier Scholarship. — $50 given by Herbert A. Currier, of the Class of 1906, to a student selected by the faculty of the Institute, the following conditions to be considered in making the selection: scholastic standing, financial need, and ability in promoting student activities in school life. To *James Oliver Ellis.*

A $20 prize for meritorious work in the department of Chemistry and Textile Coloring. To *E. Maybelle Warren.*

REGISTER OF DAY STUDENTS

Candidates for Degree

Class of 1929

Name *Home Address*	*Lowell Address*
Balch, Ralph Herman, VI, Billerica, Mass.	———
Bergeron, Alvin Wilfred, IV, Haverhill, Mass.	———
Buzzell, Harry Saville, VI, Lowell, Mass.	30 Highland Avenue
Ellis, James Oliver, VI, Chelmsford, Mass.	———
Fredrickson, Charles Joseph, Jr., IV., Andover, Mass.	———
Haynes, Amos Kempton, IV, Haverhill, Mass.	Phi Psi House
Hetherman, Patrick Joseph, IV, Lowell, Mass.	306 School Street
Holbrook, Ralph Wentworth, IV, Allston, Mass.	137 Riverside Street
Holt, Laurence Currier, VI, Lexington, Mass.	Omicron Pi House
Howorth, Harmon, VI, Lowell, Mass.	57 Dover Street
Hurd, Ira Swain, IV, Haverhill, Mass.	Omicron Pi House
Konieczny, Henry, IV, Dracut, Mass.	———
Larter, Edward Alan, VI, Lowell, Mass.	100 Riverside Street
Lindsly, Walter Coburn, IV, Lowell, Mass.	49 Nesmith Street
McGibbon, James Greig, IV, Lexington, Mass.	———
McLean, Earle Raymond, IV, Haverhill, Mass.	———
Matthews, Robert Jackson, VI, Gardner, Mass.	Omicron Pi House
Myers, Walter Flemings, VI, Lowell, Mass.	21 Albert Street
Phelan, Bernard Michael, IV, Ipswich, Mass.	Delta Kappa Phi House
Rice, Kenneth Earl, VI, Stoneham, Mass.	———
Robbins, Walter Archibald, VI, Lowell, Mass.	102 South Loring Street
Ryberg, Bertil August, IV, Centerville, Mass.	Phi Psi House
Shelton, Charles Leopold, VI, Boston, Mass.	———
Stanley, John Prince, Jr., IV, Lewiston, Maine	Phi Psi House
Westbrooke, Clayton Collington, IV, North Andover, Mass.	Omicron Pi House
Weich, Raymond Edward, IV, Lowell, Mass.	54 Hoyt Avenue
Zalkind, Benjamin Joseph, VI, Dorchester, Mass.	———

Class of 1930

Anderson, Alfred Ballard, VI, Framingham, Mass.	Omicron Pi House
Barsky, Morris, IV, Dorchester, Mass.	47 Mount Vernon Street
Beardsell, Arthur Herrick, VI, Concord, Mass.	Omicron Pi House
Beeman, Earl Royal, VI, Quincy, Mass.	9 White Street
Carbone, Alfred John, IV, Haverhill, Mass.	———
Cleveland, Richard Sumner, VI, East Pepperell, Mass.	———
Colby, Willard Alvah, Jr., IV, Bradford, Mass.	———
Dunlap, Kirke Harold, Jr., VI, Lowell, Mass.	58 Hanks Street
Gallagher, Arthur Francis, IV, Lowell, Mass.	36 Merrill Street
Greendonner, George John, IV, Stafford Springs, Conn.	63 Varnum Avenue

Gross, Herman Harold, IV, Newark, N. J.	Phi Psi House
Hale, Everett Lane, VI, Stoneham, Mass.	———
Jones, Bliss Morris, IV, Lexington, Mass.	Omicron Pi House
Jones, Mellor Adair, IV, Lowell, Mass.	Omicron Pi House
Kolsky, Samuel Irving, IV, Lawrence, Mass.	———
Kostopoulos, Emanuel Arthur, VI, Lowell, Mass.	270 Adams Street
Krishan, Maharaj, VI, Montgomery, India	125 Mount Washington St.
McDonald, Gerald Francis, IV, Lowell, Mass.	208 Mount Hope Street
McGee, Francis Patrick, IV, Lowell, Mass.	94 Beacon Street
Meady, Benjamin Balch, IV, Lexington, Mass.	———
Murphy, Sylvester, IV, Allerton, Mass.	536 Fletcher Street
Orlauski, Anthony, IV, Haverhill, Mass.	———
Preston, Harold Lawrence, VI, Wakefield, Mass.	Phi Psi House
Rand, Ralph Frederick, VI, Lowell, Mass.	495 Central Street
Ray, Lloyd Sanford, IV, West Newbury, Mass.	3 Belmont Street
Sadler, Thomas Sheridan, VI, Billerica, Mass.	———
Stacey, Alfred Charles, IV, Andover, Mass.	———
Stewart, John Weeden, IV, Brattleboro, Vt.	Phi Psi House
Tamulonis, Edward William, VI, Nashua, N. H.	———
Topjian, Leon, IV, Lowell, Mass.	98 Fremont Street

Class of 1931

Allard, Edward Joseph, IV, Lowell, Mass.	116 Ennell Street
Bagshaw, Herbert Arthur, VI, Lowell, Mass.	92 Jenness Street
Bradford, William Swanton, VI, Andover, Mass.	———
Brook, Richard Lea, IV, Simcoe, Ont.	Omicron Pi House
Burtt, Joseph Frederic, VI, Lowell, Mass.	23 Grace Street
Casey, Francis Harold, IV, Roslindale, Mass.	Delta Kappa Phi House
Danahy, Arthur Joseph, IV, Lowell, Mass.	37 Clark Street
Duggan, Paul Curran, IV, Lowell, Mass.	58 D Street
French, Wallace Howe, IV, Lowell, Mass.	636 Rogers Street
Grant, Alfred Thomas, IV, Somersworth, N. H.	98 Mount Vernon Street
Hale, Eugene Heffley, VI, Stoneham, Mass.	———
Hale, Ralph Edgar, IV, West Newbury, Mass.	272 Merrimack Street
Hall, Stanley Arundel, IV, Haverhill, Mass.	Phi Psi House
Hardman, Joseph Edwin, IV, Lowell, Mass.	485 Westford Street
Hosmer, Frank Barbour, IV, Lowell, Mass.	226 Gibson Street
Ivers, Gerald Anthony, IV, East Chelmsford, Mass.	———
Jarek, Julius, IV, Lowell, Mass.	74 Eleventh Street
Johnson, Norman Albin, IV, Deep River, Conn.	Omicron Pi House
Lathrop, John Francis, IV, South Manchester, Conn.	Delta Kappa Phi House
Lifland, Abraham, IV, Roxbury, Mass.	47 Mount Vernon Street
Loveless, Everton Hanscom, VI, Melrose, Mass.	———
Maher, Margaret Mary, IV, Lowell, Mass.	44 Keene Street
McAllister, Gordon, IV, North Billerica, Mass.	———
McDonald, John Joseph, IV, Lowell, Mass.	208 Mount Hope Street
Parker, John George, Jr., IV, Chelmsford, Mass.	———
Pero, Richard Omer, VI, Monson, Mass.	43 Plymouth Street
Peterson, Eric Arthur, IV, Lowell, Mass.	14 Winthrop Avenue
Piligian, Hiag Nishan, IV, Springfield, Mass.	98 Mount Vernon Street
Quigley, Gerald Francis, IV, Lowell, Mass.	51 Crawford Street
Rawlinson, Richard William, VI, Lowell, Mass.	430 Pine Street
Ross, William Cummings, IV, Lowell, Mass.	661 Rogers Street
Russell, Harold William, VI, Sanford, Me.	295 Appleton Street
Stewart, Alexander, VI, Andover, Mass.	———
Stifel, Edward William, Jr., IV, Wheeling, W. Va.	Omicron Pi House
Sung, Harvey, VI, Tsinanfu, China	137 Riverside Street
Toher, Francis Luke, IV, Providence, R. I.	524 Moody Street
Verry, Richard Morton, VI, Salem, Mass.	Omicron Pi House
Wallace, Max Joseph, IV, Malden, Mass.	47 Mount Vernon Street

Class of 1932

Armitstead, Russell Arthur, IV, Lowell, Mass.	628 Wilder Street
Babigan, Edward, IV, Lowell, Mass.	121 Bellevue Street
Bailey, John Mason, IV, Billerica, Mass.	———
Barry, Marie Gertrude, IV, Lowell, Mass.	31 Hoyt Avenue
Bertrand, Arthur Leon, IV, Lowell, Mass.	27 West 5th Street
Brosnan, James Henry, IV, Lowell, Mass.	100 White Street
Burke, James Edward, IV, Lowell, Mass.	77 Durant Street
Carmichael, James Robert, VI, Lowell, Mass.	59 Huntington Street
Churchill, Charles Whittier, Jr., VI, Lowell, Mass.	214 Third Street
Clark, Gerald Burrill, VI, Corinna, Me.	253 Princeton Boulevard
Cook, Vernon Stanley, VI, Lowell, Mass.	677 Westford Street
Dudley, Albert Richard, VI, Lowell, Mass.	126 Coburn Street
Farrell, Milton Atherton, IV, Lowell, Mass.	68 Forest Street
Fenn, Harris Benjamin, Jr., IV, Ridgewood, N. J.	100 Riverside Street
Ferguson, Thomas Dickson, Jr., VI, Little Falls, New York	137 Riverside Street
Fleming, Archie Crawford, IV, Lowell, Mass.	35 Methuen Street
Gleklen, Leo, IV, Lynn, Mass.	147 Riverside Street
Glowacki, Joseph, VI, Andover, Mass.	———
Greene, William Joseph, Jr., IV, Edgewood, R. I.	118 Mount Washington St.
Harrington, John, IV, Lowell, Mass.	86 School Street
Hegy, Gerard John, VI, Holyoke, Mass.	106 Crawford Street
Hockridge, Stanley Squire, IV, North Adams, Mass.	43 Plymouth Street
Howard, Lorne Fernley, IV, North Chelmsford, Mass.	———
Kennerley, Frederick Lasier, VI, Los Angeles, Calif.	142 Riverside Street
Ketover, Max Louis, VI, Franklin, Mass.	137 Riverside Street
Kiernan, John James, VI, Lowell, Mass.	22 Phillips Street
King, Daniel Joseph, IV, Lowell, Mass.	156 Pleasant Street
Lifland, Bessie, IV, Roxbury, Mass.	47 Mount Vernon Street
McDougall, Francis Gerard, VI, Lowell, Mass.	637 Broadway
McQuaid, Barton Matthewman, IV, North Billerica, Mass.	———
Macauley, Donald Carlton, VI, Lowell, Mass.	11 Fernald Street
Meehan, John Joseph, IV, Lowell, Mass.	35 Varney Street
Meinelt, Herbert Eugene, IV, Lawrence, Mass.	———
Moran, Edward Francis, IV, Lowell, Mass.	38 West 5th Street
Murphy, Daniel Francis, Jr., IV, Lowell, Mass.	197 Christian Street
O'Brien, Daniel Joseph, Jr., VI, Lowell, Mass.	90 Parkview Avenue
Orme, Frederick Joseph, VI, Providence, R. I.	Delta Kappa Phi House
Parke, Thaddeus Wheatley, Jr., VI, Lowell, Mass.	23 South Walker Street
Pizzuto, Joseph James, Jr., IV, Pittsfield, Mass.	142 Riverside Street
Savard, Aime Albert, Jr., IV, Lowell, Mass.	311 Mammoth Road
Silva, George Preston, VI, Lowell, Mass.	75 Highland Avenue
Spalding, Arthur Ovila, IV, Lowell, Mass.	84 D Street
Spaulding, Ned, IV, Hudson, N. H.	———
Stearns, Kenneth Lawrence, IV, Lowell, Mass.	43 Grace Street
Sullivan, Joseph Michael, IV, Lowell, Mass.	28 Dunfey Street
Thompson, Bertram Quaile, IV, Outremont, Que.	118 Mount Washington St.
Walker, Samuel J., IV, East Liverpool, Ohio	37 Varney Street
Wang, Yun-Cheng, VI, Shanghai, China	53 Mount Hope Street
Wojas, Stanley Edward, IV, Lowell, Mass.	24 Ray Court

Diploma Students

Class of 1929

Billings, Borden Dickinson, I, Auburndale, Mass.	———
Brook, Joseph Johnson, II, Simcoe, Ont.	Phi Psi House
Campbell, William Malcolm, III, So. Boston, Mass.	37 Varney Street

Cluett, John Girvin, I, Troy, N. Y.	153 Westford Street
Evans, Paul Richard, II, Stoneham, Mass.	———
Gaudet, Walter Urban, II, Lowell, Mass.	Delta Kappa Phi House
Greenbaum, Herbert Baron, III, Roxbury, Mass.	———
Stephens, Arnold George, I, Roslindale, Mass.	37 Varney Street
Stewart, Earl Stanley, II, Somerville, Mass.	272 Merrimack Street

Class of 1930

Carleton, Joseph Raddin, III, Bradford, Mass.	———
Carpenter, Carleton Warner, II, Lowell, Mass.	14 Staples Street
Garner, Allen Frank, II, Kezar Falls, Me.	98 Mount Vernon Street
Kilmartin, John Joseph, I, Lowell, Mass.	62 Highland Avenue
Peary, John Ervin, III, Wilton, Me,	272 Merrimack Street

Class of 1931

Bacon, Charles Fullerton, Jr., II, Providence, R. I.	Omicron Pi House
Brooks, Thomas William, III, Lowell, Mass.	98 Gates Street
Currier, Leslie Frank, III, Lowell, Mass.	234 Parker Street
Daley, Raymond Joseph, II, Lowell, Mass.	239 Stevens Street
Demarco, Henry, I, Shelton, Conn.	137 Riverside Street
Farrell, John, III, Boston, Mass.	142 Riverside Street
Goulson, Walter Seth, III, Lowell, Mass.	99 Sayles Street
Hunter, Charlie Hannibal, II, Anson, Me.	Omicron Pi House
Scadding, Margaret Gray, III, Lowell, Mass.	100 Park Avenue, East
Taft, David Russell, II, Oxford, Mass.	43 Plymouth Street
Tang, Hsiung Yuan, I, Wusik, Ku, China	53 Mount Hope Street
Truesdale, Elmer Vine, III, Lewiston, Me.	43 Plymouth Street
Williams, Albert William, III, Lowell, Mass.	178 First Street

Special Students

Herrmann, Edward Frank, IV, New York, N. Y.	98 Mount Vernon Street
Mack, James Edward, II, Unionville, Conn.	272 Merrimack Street
Mackie, Robert Forrest, IV, Bradford, Pa.	14 Mount Washington St.
Marble, Roger Houghton, VI, Worcester, Mass.	Phi Psi House
Montminy, Joseph Francis, Jr., IV, Lowell, Mass.	723 Moody Street
Morse, Richard Hale, VI, Haverhill, Mass.	Phi Psi House
Niles, Francis Bernard, III, Somerville, Mass.	142 Riverside Street
Salisbury, Clarence Linwood, III, Moosup, Conn.	Delta Kappa Phi House
Sewall, Roy Pishon, III, Maynard, Mass.	———
Pratt, Frank, II, Woonsocket, R. I.	———

Experimental Dyeing Laboratory

ALPHABETICAL LIST OF GRADUATES

The following list has been corrected in accordance with information received previous to February 1, 1929. Any information regarding incorrect or missing addresses is earnestly solicited.

B.T.C. indicates the degree of Bachelor of Textile Chemistry; B.T.D. indicates the degree of Bachelor of Textile Dyeing; B.T.E. indicates the degree of Bachelor of Textile Engineering; D indicates a diploma; C indicates a certificate (covering a partial course only). Degrees were issued beginning with the year 1913.

Abbot, Edward Moseley, II, '04 (D.) Agent and Vice President, Abbot Worsted Company, Graniteville, Mass.

Abbott, George Richard, II, '08 (D). Andover, Mass.

Adams, Floyd Willington, VI, '16 (B.T.E.). Superintendent, The Barrett Company, Peoria, Ill.

Adams, Henry Shaw, I, '05, (D). Secretary and Treasurer, Eureka Cotton Mills and The Springstein Mills, Chester, S. C.

Adams, Tracy Addison, IV, '11 (D). General Manager, Arnold Print Works, North Adams, Mass.

Albrecht, Charles Henry, IV, '17 (B.T.C.). Chief Chemist, Bell Company, Worcester, Mass.

Almquist, George John Edwin, I, '19 (D). Second Vice-President, Passaic-Bergen Lumber Company, Ridgewood, N. J.

Anderson, Arthur Illman, IV, '24 (B.T.C.). Chemist, Laundry Owners National Association, Mellon Institute, Pittsburg, Pa.

Anderson, Arthur Julius, IV, '19 (B.T.C.). Salesman, National Aniline and Chemical Company, 40 Rector Street, New York City.

Anderson, Clarence Alfred, VI, '25 (B.T.E.). Time Study Engineer, Mohawk Carpet Mills, Inc., Amsterdan, N. Y.

Anderson, Harold Robert, II, '26 (D). Assistant Sales Manager, American Mason Safety Tread Company, Lowell, Mass.

Annan, David, II, '23 (D). With Everlastik, Inc., 180 Spencer Avenue, Chelsea, Mass.

Arienti, Peter Joseph, IV, '10 (D). Chief Chemist and Dyer, Sayles Finishing Plants, Inc., Saylesville, R. I.

Arundale, Henry Barnes, II, '07 (D.) Research Department, United States Testing Company, Inc., 316 Hudson Street, New York City.

Atwood, Henry Jones, II, '23 (D). Designer, Leominster Worsted Company, Leominster, Mass.

Avery, Charles Henry, II, '06 (D). Died January, 1913.

Babigan, Raymond, IV, '24 (B.T.C.). Patent Examiner, United States Patent Office, Washington, D. C.

Bachelder, Charles Edward, IV, '24 (B.T.C.). Plant Chemist, Slatersville Finishing Company, Slatersville, R. I.

Bailey, Joseph W., I, '99 (D). Agent, Booth Manufacturing Company, New Bedford, Mass.

Bailey, Lester Harold, IV, '24 (B.T.C.). Textile Chemist, Tubize Artificial Silk Company, 305 Fifth Avenue, New York City.

Bailey, Walter James, IV, '11 (D). Bailey's Cleansers and Dyers, Watertown, Mass.

Baker, Franz Evron, VI, '26 (B.T.E.). Instructor, Cotton Yarn Department, Lowell Textile Institute, Lowell, Mass.

Baker, Maurice Sidney, IV, '25 (B.T.C.). Merchant, Attleboro, Mass.

Baker, William John, IV, '16 (D). Supervisor, Du Pont Rayon Company, Old Hickory, Tenn.

Baker, William Samuel, I, '26 (D). Assistant Systemizer, Nashua Manufacturing Company, Nashua, N. H.

Baldwin, Arthur Lincoln, IV, '00 (D). Died December 1, 1919.

Baldwin, Frederick Albert, II, '04 (D). Vice-President and Secretary, Walter Blue & Co., Ltd., Sherbrooke, Que.

Ballard, Horace W. C. S., IV, '08 (D). Died September 28, 1918.
Barlofsky, Archie, VI, '17 (B.T.E.). Merchant, Economy Cash Market, 165 Chelmsford Street, Lowell, Mass.
Barr, I. Walwin, I, '00 (D). Second Vice-President, Buckley Brothers Company, 881 Boadway, New York City.
Barrett, Andrew Edward, IV, '23 (B.T.C.). Dyer, Bradford Dyeing Association, Bradford, R. I.
Barry, Leo Joseph, II, '27 (D). With Wuskanut Mills, Inc., Farnumsville, Mass.
Bauer, Harold Conrad, III, '28 (D). Assistant Designer, Merrimac Mills, Methuen, Mass.
Beck, Frederic Christian, II, '24 (D). In business, Weld & Beck, Southbridge, Mass.
Bell, Edward Benjamin, IV, '24 (B.T.C.). Dyer, Primrose Dyeing Company, 352 Woodward Street, Jersey City, N. J.
Bennett, Edward Howard, II, '03 (C). Publisher, American Wool and Cotton Reporter, 530 Atlantic Avenue, Boston, Mass.
Bennett, Herbert Bowen, II, '13 (D). Died January 23, 1920.
Bentley, Byron, II, '26 (D). With Joseph Bentley Hair Company, Methuen, Mass.
Berry, Wilbur French, II, '17 (D). President and Treasurer, Wilbur Manufacturing Company, Providence, R. I.
Bienstock, George Jerrard, III, '24 (D). Styler and Designer, Henry W. T. Mali & Co., 257 Fourth Avenue, New York City.
Bigelow, Prescott Fenno, II, '12 (D). Died October 14, 1918.
Bird, Clarence Henry, II, '22 (D). Assistant Superintendent, Worcester Woolen Mill Company, Worcester, Mass.
Bird, Francis John, VI, '22 (B.T.E.). 30 West Street, Attleboro, Mass.
Blaikie, Howard Mills, II, '11 (D). Salesman and Assistant Styler, American Woolen Company, 225 Fourth Avenue, New York City.
Blake, Parker Gould, VI, '14 (D). District Manager, Claude Denis & Co., Ltd., Toronto, Ont.
Blanchard, John Lawrence, II, '23 (D). Designer, Farnsworth Company, Lisbon Centre, Me.
Bloom, Wilfred Nathaniel, IV, '03 (D). Died August 17, 1918.
Bodwell, Henry Albert, II, '00 (D). With Ludlow Manufacturing Associates, 80 Federal Street, Boston, Mass.
Booth, James Mooney, IV, '24 (B.T.C.). Salesman, The Huron Milling Company, Inc., 9 Park Place, New York City.
Bottomley, John, III, '28 (D). With President Suspender Company, Shirley, Mass.
Boyd, George Andrew, I, '05 (D). Treasurer, Appleton Company, 79 Milk Street, Boston, Mass.
Boylston, Theodore Willmott, IV, '21 (B.T.C.). Died June 3, 1921.
Brackett, Martin Richard, II, '22 (D). With Mackay, Sigler & Taylor, 215 Fourth Avenue, New York City.
Bradford, Harold Palmer, II, '25 (D). 90 Beach Street, Malden, Mass.
Bradford, Roy Hosmer, II, '06 (D). 161 Devonshire Street, Boston, Mass.
Bradley, Raymond Frost, VI, '14 (D). Garage Proprietor, Twin Light Garage, 267 East Main Street, Gloucester, Mass.
Bradley, Richard Henry, V, '01 (C). Overseer, Wamsutta Manufacturing Company, New Bedford, Mass.
Brainerd, Arthur Travena, IV, '09 (D). Manager, Chicago Office, Ciba Company, 233 West Huron Street, Chicago, Ill.
Brainerd, Carl Emil, IV, '20 (B.T.C.). Overseer of Dyeing, F. C. Huyck & Sons, Albany, N. Y.
Brainerd, Carroll Lewis, IV, '19 (B.T.C.). Died May 28, 1928.
Brandt, Carl Dewey, VI, '20 (B.T.E.) Assistant to Agent, Bondsville Bleachery and Dye Works, Bondsville, Mass.
Brannen, Leon Vincent, III, '07 (C).
Brickett, Chauncy Jackson, II, '00 (D). Director Textile Schools, International Correspondence School, Scranton, Pa.

Brickett, Raymond Calvin, II, '14 (D). Overseer, M. T. Stevens & Sons Company (Marland Mills), Andover, Mass.
Brigham, Howard Mason, VI, '24 (B.T.E.). With Wellington, Sears & Co., 65 Worth Street, New York City.
Bronson, Howard Seymour, II, '27 (D). Overseer of Knitting, Portage Hosiery Company, Portage, Wis.
Brosnan, William Francis, IV, '27 (B.T.C.). Superintendent, Antipyros Company, 551 West 52d Street, New York City.
Brown, Gerald Marston, VI, '22 (B.T.E.). With Cheney Brothers, South Manchester, Conn.
Brown, Phillip Franklin, II, '23 (D). District Sales Manager, DuPont Rayon Company, Buffalo, N. Y.
Brown, Rollins Goldthwaite, IV, '12 (D). Sales Representative, White Brothers, Inc., Winchendon Springs, Mass.
Brown, Russell Lee, VI, '21 (B.T.E.). Assistant Professor, Lowell Textile Institute, Lowell, Mass.
Brown, Will George, Jr., IV, '22 (B.T.C.). Chemist, American Hide & Leather Company, Lowell, Mass.
Buchan, Donald Cameron, II, '01 (D). Assistant Superintendent, M. T. Stevens & Sons Company, North Andover, Mass.
Buchan, Norman Spaulding, IV, '26 (B.T.C.). Overseer of Dyeing, Pitman Manufacturing Company, Laconia, N. H.
Burbeck, Dorothy Maria, IV, '20 (B.T.C.). See Garlick, Mrs. Dorothy M.
Burger, Samuel Joseph, III, '24 (D). Buyer, Max Burger & Co., New York City.
Burnham, Frank Erwin, IV, '02 (D). Chief Chemist, Farwell Bleachery, Lawrence, Mass.
Burns, Robert, IV, '28 (B.T.C.). With Cellanese Corporation of America, Amcelle, Md.
Burrage, Katharine C., IIIb, '99 (C). Died May 16, 1914.

Callahan, John Joseph, Jr., II, '26 (D). Color Chemist, A. Klipstein & Co., 263 Summer Street, Boston, Mass.
Cameron, Elliott Francis, IV, '11 (D). Treasurer, Amos F. Chase Company, Inc., 13 Otis Street, Boston, Mass.
Campbell, Alexander, VI, '23 (B.T.E.). Mechanical Engineer, Charles T. Main, Inc., Engineers, 201 Devonshire Street, Boston, Mass.
Campbell, Laura Etta, IIIb, '00 (C). Deceased.
Campbell, Louise Porter, IIIb, '03 (C). With Ginn & Co., 15 Ashburton Place, Boston, Mass.
Campbell, Orison Sargent, II, '03 (D). Manager Felt Department, Canadian Consolidated Felt Company, Ltd., Kitchener, Ont.
Cannell, Philip Stuart, VI, '23 (B.T.E.). Industrial Engineer, MacDonald Brothers, Inc., 6 Foster Street, Everett, Mass.
Carr, George Everett, I, '05 (D).
Carr, Paul Edward, II, '24 (D). Designer, Camden Woolen Company, Camden, Maine.
Carter, Robert Albion, IV, '02 (D). Salesman, E. I. du Pont de Nemours & Co., 128 South Front Street, Philadelphia, Pa.
Carter, Russell Albert, II, '25 (D). Planning Department, Dennison Manufacturing Company, Marlboro, Mass.
Cary, Julian Clinton, VI, '10 (D). Branch Manager, American Mutual Liability Insurance Company, 226 Pearl Street, Hartford, Conn.
Caya, Ferdinand Joseph, IV, '22 (B.T.C.). Superintendent of Dyeing, Gotham Silk Hosiery Company, Inc., Wharton, N. J.
Chamberlin, Frederick Ellery, I, '03 (D). Overseer of Spinning, Monument Mills, Housatonic, Mass.
Chandler, Proctor, IV, '11 (D). President and Manager, Chandler Manufacturing Company, 28 Carleton Street, Cambridge, Mass.
Chang, Chi, VI, '23 (B.T.E.).
Chang, Wen Chuan, VI, '21 (B.T.E.). Dah Sung Cotton Mill No. 1, Nantung, Kiangsu, China.

Chapman, Leland Hildreth, VI, '24 (B.T.E.). Principal, Ashby High School, Ashby, Mass.
Chen, Shih Ching, IV, '22 (B.T.C.). Hou Sung Cotton Mill, Shanghai, China.
Chen, Wen-Pei, IV, '24 (B.T.C.).
Chisholm, Lester Bury, I, '11 (D). General Plant Manager, American Mills Company, Waterbury, Conn.
Church, Charles Royal, II, '06 (C).
Churchill, Charles Whittier, III, '06 (D). Manager, Churchill Manufacturing Company, Inc., Lowell, Mass.
Clapp, Frank Austin, II, '04 (D).
Clark, Earl William, IV, '18 (B.T.C.). Research Chemist, Cheney Brothers, South Manchester, Conn.
Clark, Thomas Talbot, II, '10 (D). Treasurer, Talbot Mills, North Billerica, Mass.
Clarke, George Dean, II, '21 (C). Dyer, Seaman & Cobb Thread Mills, Hopkinton, Mass.
Clayton, Harold Edmund, VI, '21 (B.T.E.). Superintendent, Bottum & Torrance Co., Bennington, Vt.
Cleary, Charles Joseph, II, '13 (D). Textile Technologist, United States Army Air Service, Wright Field, Dayton, Ohio.
Clement, David Scott, IV, '24 (B.T.C.). Chemist, Nashua Manufacturing Company, Nashua, N. H.
Clifford, Albert Chester, VI, '22 (B.T.E.). Textile Engineer, Western Electric Company, Inc., Kearny, N. J.
Clogston, Raymond B., IV, '04 (D). Superintendent of Dyeing, Merrimack Manufacturing Company, Lowell, Mass.
Coan, Charles Bisbee, IV, '12 (D).
Coffey, Daniel Joseph, III, '28 (D). 128 Brown Street, Pittsfield, Mass.
Cohen, Arthur Edward, IV '23 (B.T.C.).
Cohen, Raphael Edvab, IV, '25 (B.T.C.). Secretary and Sales Manager, Merrimack Paper Tube Company, Inc., Lowell, Mass.
Colby, James Tracy, VI, '16 (D). Salesman, F. C. Huyck & Sons, Albany, N. Y.
Cole, Edward Earle, IV, '06 (D). Financial Agent, The Bradstreet Company, Boston, Mass.
Cole, James Thomas, II, '05 (D). Treasurer, Arlington Industries for the Blind, Arlington, Mass.
Collonan, Herbert Joseph, II, '22 (D). Designer, Beoli Mills, Fitchburg, Mass.
Coman, James Groesbeck, I, '07 (D). Superintendent, Mexia Textile Mills, Mexia, Texas.
Conant, Harold Wright, I, '09 (D). Assistant Treasurer, United Elastic Corporation, Easthampton, Mass.
Conant, Richard Goldsmith, I, '12 (D). Sales Executive, Wellington, Sears & Co., 65 Worth Street, New York City.
Conklin, Jennie Grace, IIIb, '05 (C). See Nostrand, Mrs. William L.
Connor, Thomas Francis, II, '28 (D). Salesman, Pacific Mills, 25 Madison Avenue, New York City.
Connorton, John Joseph, Jr., III, '27 (D). Assistant Designer, Amoskeag Manufacturing Company, Manchester, N. H.
Cook, Kenneth Bartlett, I, '13 (D). General Manager, Southern Mills, Manville-Jenckes Company, Pawtucket, R. I.
Corbett, James Francis, IV, '28 (B.T.C.). Chemist, Pacific Mills, Lawrence, Mass.
Cosendai, Edwin Frederick Ernest, IV, '15 (B.T.D.). Died November 1, 1923.
Cote, Theodore Charles, IV, '26 (B.T.C.). Research Chemist, Pacific Print Works, Lawrence, Mass.
Craig, Albert Wood, IV, '07 (D). Superintendent, Windsor Print Works, North Adams, Mass.
Craig, Clarence Eugene, III, '02 (D).
Creese, Guy Talbot, IV, '14 (D). Chemist, Creese & Cook Company, Danversport, Mass.

Crowe, Joseph Bailey, IV, '25 (B.T.C.). Textile Chemist, Procter & Gamble Co., Paterson, N. J.

Culver, Ralph Farnsworth, IV, '04 (D). Vice-President and Manager, Providence Office, Ciba Company, Inc., 61 Peck Street, Providence, R. I.

Cummings, Edward Stanton, VI, '16 (D). Industrial Engineer, with R. E. Loper & Co., Greenville, S. C.

Curran, Charles Ernest, III, '02 (C). Head Designer, Wood Worsted Mills, Lawrence, Mass.

Currier, Herbert Augustus, I, '06 (D). Cotton Yarn Merchant, Waterman, Currier & Co., Inc., 40 Worth Street, New York City.

Currier, John Alva, II, '01 (D). Superintendent, Pentucket Mills (M. T. Stevens & Sons Company), Haverhill, Mass.

Curtis, Frank Mitchell, I, '06 (D). Retail Lumber, Wm. Curtis Sons Company, 10 Blue Hill Avenue, Milton, Mass.

Curtis, William Leavitt, II, '05 (C).

Cutler, Benjamin Winthrop, Jr., III, '04 (D). With Fred Butterfield & Co., Inc., 361 Broadway, New York City.

Cuttle, James H., II, '99 (D). Superintendent, S. Stroock & Co., Inc., Newburgh, N. Y.

Dalton, Gregory Smith, IV, '12 (D).

Darby, Avard Nelson, II, '28 (D). With Merrimac Hat Corporation, Amesbury, Mass.

Datar, Anant Vithal, VI, '24 (B.T.E.). Secretary and Manager, The Pulgaon Cotton Manufacturing Company, Ltd., Pulgaon, C. P., India.

Davidson, Sydney, III, '28 (D). 64 Devon Street, Roxbury, Mass.

Davieau, Alfred Edward, VI, '16 (D). In charge of Textile Testing, United States Testing Company, Inc., 316 Hudson Street, New York City.

Davieau, Arthur Napoleon, VI, '13 (D). Superintendent, Kenwood Mills, Ltd. (F. C. Huyck & Sons), Arnprior, Ont.

Davieau, Leon Arthur, VI, '23 (B.T.E.). With United States Rubber Company, 451 South Jefferson Street, Orange, N. J.

Davis, Alexander Duncan, VI, '14 (B.T.E.). Instructor, Northeastern University, Springfield, Mass.

Dearborn, Roy, VI, '13 (D). Salesman, Dumas & Co., Lowell, Mass.

Dearth, Elmer Elbridge, IV, '12 (D). Manager, Product Development, Fisk Rubber Company, Chicopee Falls, Mass.

Del Plaine, Parker Haywood, IV, '25 (B. T.C.). Textile Chemist, Rohm & Haas Company, Bristol, Pa.

Derby, Roland Everett, IV, '22 (B.T.C.). Head Chemist, M. T. Stevens & Sons Company, North Andover, Mass.

de Sa, Francisco, VI, '18 (B.T.E.). Avenue da Graca, Bahia, Brazil.

Dewey, James French, II, '04 (D). Woolen Manufacturer, A. G. Dewey Company, Quechee, Vt.

Dewey, Maurice William, II, '11 (D). Inspector of Real Estate and Real Estate Loans, National Life Insurance Company, Montpelier, Vt.

Dillon, James Henry, III, '05 (D).

Dods, James Barber, II, '27 (D). Vice-President and General Manager, The Dods Knitting Company, Ltd., Orangeville, Ont.

Dolan, William Francis, IV, '28 (B.T.C.). Assistant Dyer, Lowell Dye Works, Lowell, Mass.

Donald, Albert Edward, II, '04 (D). Agent, H. T. Hayward Company, Franklin, Mass.

Donovan, Joseph Richard, IV, '24 (B.T.C.). Proprietor, Scientific Laundry, 484 Main Street, Charlestown, Mass.

Doran, Wilbur Kirkland, II, '22 (D). State Manager, Investors Syndicate, Providence, R. I.

Dorr, Clinton Lamont, VI, '14 (D). With Raymond Syndicate, 356 Washington Street, Boston, Mass.

Douglas, Walter Shelton, II, '21 (D). Estimator, Douglas & Co., Lowell, Mass.

Duguid, Harry Wyatt, I, '24 (D). Office Manager, Maverick Mills, East Boston, Mass.

Dunnican, Edward Tunis, VI, '24 (B.T.E.). With Pacific Mills, 24 Thomas Street, New York City.

Durgin, William Ernest, IV, '24 (B.T.C.). Chemist, Geigy Company, Inc., 88 Broad Street, Boston, Mass.

Duval, Joseph Edward, II, '10 (D). Yarn Agent, 308 Chestnut Street, Philadelphia, Pa.

Dwight, John Francis, Jr., II, '08 (D). Proprietor, Humarock Inn, Humarock Mass.

Echmalian, John Gregory, VI, '16 (B.T.E.). Supervisor of Training for Cheney Brothers, So. Manchester, Conn.

Ehrenfried, Jacob Benjamin, II, '07 (C). Manager, George Ehrenfried Company, Lewiston, Maine.

Elliot, Gordon Baylies, II, '12 (D). Production Work, Pacific Mills, Lawrence, Mass.

Ellis, Charles Albert, VI, '21 (B.T.E.). With Atmospheric Nitrogen Company, Syracuse, N. Y.

Ellis, Dorothy Myrta, VI, '25 (B.T.E.). Department of Agriculture, Bureau of Home Economics, Washington, D. C.

Emerson, Frank Warren, II, '03 (D). 56 Washington Street, Penacook, N. H.

Engstrom, Karl Emil, VI, '12 (D). **(S.B. 1916, Massachusetts Institute of Technology.)** With Lockwood, Greene & Co., Boston, Mass.

Enloe, Winfred Paige, I, '22 (D). Assistant Superintendent, The W. A. Handley Manufacturing Company, Roanoke, Ala.

Evans, Alfred Whitney, III, '03 (D).

Evans, William Robinson, III, '03 (D). 309 Main Street, Bradford, Mass.

Everett, Charles Arthur, IV, '19 (B.T.C.). Instructor, Dyeing Department, Lowell Textile Institute, Lowell, Mass.

Ewer, Nathaniel Trull, IV, '01 (D). Chemist, American Dyewood Company, Chester, Pa.

Fairbanks, Almonte Harrison, II, '09 (D). Treasurer and Manager, Middlesex Knitting Company, Wakefield, Mass.

Farley, Clifford Albert, VI, '28 (B.T.E.). 215 Princeton Boulevard, Lowell, Mass.

Farmer, Chester Jefferson, IV, '07 (D). **(Ph.D. Harvard University.)** Professor of Chemistry, Northwestern University Medical School, Chicago, Ill.

Farnsworth, Harold Vincent, VI, '16 (B.T.E.). Textile Engineer, Atkinson, Haserick & Co., 152 Congress Street, Boston, Mass.

Farr, Leonard Schaefar, II, '08 (D). Assistant Superintendent, No. 2 Mill, Farr Alpaca Company, Holyoke, Mass.

Farwell, Claude Chapman, VI, '23 (B.T.E.). Teaching, Story High School, Manchester, Mass.

Farwell, Ray Baldwin, VI, '24 (B.T.E.). Died July 6, 1926.

Fasig, Paul Leon, IV, '28 (B.T.C.). Junior Fellow, Industrial Research, Mellon Institute of Industrial Research, Pittsburgh, Pa.

Feinberg, Benjamin, II, '27 (D). Salesman, National Mill Supply Company, 184 Summer Street, Boston, Mass.

Feindel, George Paul, IV, '24 (B.T.C.). Chemist, Union Bleachery, Greenville, S.C.

Feldstein, Martin Alexander, VI, '24 (B.T.E.). Chief, The Best Radio Service Laboratories, Brooklyn, N. Y.

Fels, August Benedict, II, '99 (D).

Ferguson, Arthur Feiling, I, '03 (D). With United States Tariff Commission, Washington, D. C.

Ferguson, William Gladstone, III, '09 (D). Assistant Agent, Ludlow Manufacturing Associates, Ludlow, Mass.

Ferris, Arthur Leon, II, '28 (D). Port Rowan, Ont.

Finlay, Harry Francis, IV, '10 (D). Demonstrator, National Aniline and Chemical Company, Boston, Mass.

Fisher, Russell Todd, VI, '14 (D), '25 (B.T.E.). Secretary, National Association of Cotton Manufacturers, 80 Federal Street, Boston, Mass.

Fiske, Starr Hollinger, II, '09 (D). 1 Rhodora Street, Lowell, Mass.

Fitzgerald, John Francis, IV, '18 (B.T.C.). Dyer, Boston Dye House, Inc., Malden, Mass.

Fitzgerald, John Francis, IV, '28 (B.T.C.). Chemist, Pacific Mills, Lawrence, Mass.

Fleischmann, Meyer, IV, '20 (B.T.C.). Chief Chemist, Real Silk Hosiery Mills, Indianapolis, Ind.

Fleming, Frank Everett, IV, '06 (D). Overseer, Dyeing and Finishing, Goodall Worsted Company, Sanford, Maine.

Fletcher, Howard Varnum, III, '25 (D). With North Billerica Company, North Billerica, Mass.

Fletcher, Roland Hartwell, VI, '10 (D). With Pressed Steel Car Company, McKees Rocks, Pa.

Flood, Thomas Henry, IV, '27 (B.T.C.). Chemist, Delawanna Bleachery & Printing Co., Delawanna, N. J.

Flynn, Thomas Patrick, IV, '11 (D). Sales Manager, E. L. Thompson Chair Corporation, Baldwinsville, Mass.

Ford, Edgar Robinson, IV, '11 (D). Technical Superintendent, Sayles Biltmore Bleacheries, Biltmore, N. C.

Ford, Stephen Kenneth, IV, '28 (B.T.C.). Chemist, Cheney Brothers, South Manchester, Conn.

Forsaith, Charles Henry, VI, '20 (B.T.E.). Superintendent, Nashua Manufacturing Company (Jackson Mills), Nashua, N. H.

Forsaith, Ralph Allen, VI, '16 (B.T.E.). With Saco-Lowell Shops, 147 Milk Street, Boston, Mass.

Forsyth, Harold Downes, VI, '23 (B.T.E.). Treasurer, Wm. Forsyth & Sons Co., Lynn, Mass.

Foster, Boutwell Hyde, VI, '17 (B.T.E.). Manager, Textile Section, United States Rubber Company, 451 South Jefferson Street, Orange, N. J.

Foster, Clifford Eastman, II, '01 (D). Salesman, Wickwire Spencer Steel Company, 41 East 42d Street, New York City.

Fowle, Edwin Daniels, VI, '24 (B.T.E.). Associate Editor, "Textile World," 65 Franklin Street, Boston, Mass.

Franks, Jerome, VI, '27 (B.T.E.). Student, Massachusetts Institute of Technology, Cambridge, Mass.

Frost, Harold Benjamin, II, '12 (D). Salesman, Liberty Mutual Insurance Company, Boston, Mass.

Fuller, Allen Reed, IV, '17 (B.T.C.). Chemist, Otis Company, Three Rivers, Mass.

Fuller, George, I, '03 (D). Assistant to the President, Riverside & Dan River Cotton Mills, Inc., Danville, Va.

Gadsby, Arthur Norton, II, '13 (D). Deceased.

Gahm, George Leonhard, II, '06 (D). Superintendent, Yarn Department, Wood Worsted Mills, Lawrence, Mass.

Gainey, Francis William, IV, '11 (D). Assistant Superintendent, Cheney Brothers, South Manchester, Conn.

Gale, Harry Laburton, III, '10 (D). Manager, Colored Goods Department, Iselin-Jefferson Company, 328 Broadway, New York City.

Gallagher, John Waters, II, '27 (D). 17 Robinson Avenue, Danbury, Conn.

Garlick, Mrs. Dorothy M. (Burbeck, Dorothy M.), IV, '20 (B.T.C.) Great Road, Maynard, Mass.

Gay, Olin Dow, II, '08 (D). President, Gay Brothers Company, Cavendish, Vt.

Gerrish, Henry Kilborn, III, '16 (D). Died September 18, 1922.

Gerrish, Walter, III, '03 (D).

Gillie, Stanley James, I, '22 (D). Assistant Manager, United States Testing Company, Inc., 207 Chestnut Street, Philadelphia, Pa.

Gillon, Sara Agnes, IIIb, '06 (C).

Gilman, Ernest Dana, II, '26 (D). With Pacific Mills, Lawrence, Mass.

Glickman, Bernhardt Brecher, IV, '27 (B.T.C.). Sample Dyer, Gotham Silk Hosiery Company, New York City.

Godfrey, Harold Thomas, VI, '26 (B.T.E.). Card Erector, Davis & Furber Machine Co., North Andover, Mass.

Goldberg, George, VI, '10 (D). Salesman, Liberty Lace and Braid Company, 88 Bedford Street, Boston, Mass.

Goldenberg, Louis, VI, '27 (B.T.E.). Foreman and Mechanic of Knitting, Argus Knitting Mills, Lebanon, Pa.

Goldman, Moses Hyman, IV, '20 (B.T.C.). Superintendent and Chemist, Eagle Dye Works, 396 Woodland Street, Hartford, Conn.

Goller, Harold Poehlmann, II, '23 (D). Sales Department, Du Pont Rayon Company, Reading, Pa.

Goodhue, Amy Helen, IIIb, '00 (C). See Harrison, Mrs. Arthur.

Gooding, Francis Earle, IV, '19 (B.T.C.). Foreman, Calco Chemical Company, Bound Brook, N. J.

Goosetrey, Arthur, IV, '21 (B.T.C.). La Pas, Bolivia.

Goosetrey, John Thomas, IV, '21 (B.T.C.). Chemist and Dyer, Rhode Island Lace Company, Inc., West Barrington, R. I.

Gottschalck, Lawrence William, VI, '28 (B.T.E.). Ambassador of Trade, Russell Manufacturing Company, 51 Columbus Avenue, New York City.

Gould, Norman Culver, VI, '19 (B.T.E.). Textile Engineer, F. C. Huyck & Sons, Albany, N. Y.

Greenberg, Archie, II, '21 (D). Treasurer, M. H. Corash Company, Inc., Worcester, Mass.

Greenwood, John Roger, Jr., II, '27 (D). 8 Burbank Street, Millbury, Mass.

Guild, Lawrence Winfield, VI, '27 (B.T.E.). Investigator, Lorraine Manufacturing Company, Pawtucket, R. I.

Gwinnell, George Harry, II, '25 (D). Designer, Berkshire Woolen Company, Pittsfield, Mass.

Gyzander, Arne Kolthoff, IV, '09 (D). Chemist, American Velvet Company, Stonington, Conn.

Haddad, Nassib, VI, '23 (B.T.E.). Textile Engineer, United States Rubber Company, Orange, N. J.

Hadley, Richard Francis, IV, '22 (B.T.C.). Salesman, Carbon, Coal & Coke Company, 85 Devonshire Street, Boston, Mass.

Hadley, Walter Eastman, IV, '08 (D). Chief Chemist, The Clark Thread Company, Newark, N. J.

Hadley, Wilfred Nourse, II, '22 (D). With Parks & Woolson Company, Springfield, Vt.

Hager, Hazen Otis, II, '21 (C). Treasurer and Manager, Suburban Gas and Equipment Company, Portland, Maine.

Hall, Frederick Kilby, VI, '24 (B.T.E.). Textile Technologist, United States Bureau of Standards, Washington, D. C.

Halsell, Elam Ryan, I, '04 (C). Assistant Superintendent, Whittenton Manufacturing Company, Taunton, Mass.

Hammond, Chester Twombly, II, '23 (D). Assistant to Wool Buyer, Mohawk Carpet Mills, Inc., Amsterdam, N. Y.

Hanscom, Edwin Thomas, II, '27 (D). Assistant Superintendent, Hartford Woolen Mills, Hartford, Vt.

Hardie, Newton Gary, I, '23 (D). Superintendent, Oconee Mills Company, Westminster, S. C.

Hardy, Philip Lewis, VI, '10 (D). Contractor, Andover, Mass.

Harmon, Charles Francis, I, '99 (D).

Harrington, Thomas, IV, '15 (D). Superintendent, Monarch Leather Company, 1127 West Division Street, Chicago, Ill.

Harris, Charles Edward, I, '05 (D). Manager, Martin Fifth Wheel and Trailer Corporation, Easthampton, Mass.

Finishing Department

Harris, George Simmons, I, '02 (C). President and General Manager, Exposition Cotton Mills, Atlanta, Ga.

Harrison, Mrs. Arthur (Goodhue, Amy Helen), IIIb, '00 (C). R. F. D. No. 2, Lowell, Mass.

Hart, Arthur Norman, IV, '19 (B.T.C.). Chemist, Crystal Analysis Company, Chicago, Ill.

Hart, Edward Roscoe, I, '23 (D). Superintendent, Victory Manufacturing Company, Fayetteville, N. C.

Haskell, Spencer Howard, II, '07 (D). Deceased.

Haskell, Walter Frank, IV, '02 (D). Overseer of Dyeing, Dana Warp Mills, Westbrook, Maine.

Hassett, Paul Joseph, IV, '12 (D). Production Manager, Cortland Works, L. C. Smith & Corona Typewriters, Inc., Syracuse, N. Y.

Hathaway, William Tabor, II, '26 (D). With Hampton Company, Easthampton, Mass.

Hathorn, George Wilmer, IV, '07 (D). Chemist, Lawrence Gas Company, Lawrence, Mass.

Hathorne, Berkeley Lewis, IV, '24 (B.T.C.). Research Chemist, Tubize Artificial Silk Company of America, Washington, D. C.

Hay, Ernest Crawford, II, '11 (D). Superintendent, Monomac Spinning Company, Lawrence, Mass.

Hendrickson, Walter Alexander, II, '11 (D). With National Knitting Company, 905 Clinton Street, Milwaukee, Wis.

Hennigan, Arthur Joseph, II, '06 (D). President, Seneca Manufacturing Company, and New England Representative, Cox & Schreiber, of New York, 225 Fourth Avenue, New York City.

Hibbard, Frederick William, IV, '25 (B.T.C.). Salesman, Twin Mutuals Insurance Companies, Lawrence, Mass.

Hildreth, Harold William, II, '07 (D). Draftsman, C. G. Sargent's Sons Corporation, Graniteville, Mass.

Hillman, Ralph Greeley, VI, '22 (B.T.E.). Assistant Superintendent, Samson Cordage Works, Shirley, Mass.

Hindle, Milton, VI, '25 (B.T.E.). With F. C. Huyck & Sons, Albany, N. Y.

Hintze, Thomas Forsyth, I, '06 (C).

Hodge, Harold Bradley, VI, '22 (B.T.E.). With Cheney Brothers, South Manchester, Conn.

Hoffman, Richard Robert, II, '21 (C). With Beoli Mills, Fitchburg, Mass.

Holden, Francis Crawford, IV, '09 (D). Chemist, Chelsea Fibre Mills, 1155 Manhattan Avenue, Brooklyn, N. Y.

Holden, John Sanford, II, '20 (D). Manufacturer, Automatic Machine Products Company, Attleboro, Mass.

Holgate, Benjamin, III, '02 (C). Agent, Boott Mills, Lowell, Mass.

Hollings, James Louis, I, '05 (D). Buyer and Converter (Cotton Goods), W. R. Grace & Co., 7 Hanover Square, New York City.

Hollstein, William Diedrick, VI, '25 (B.T.E.). Junior Salesman, Schwarzenbach, Huber & Co., New York City.

Holmes, Otis Milton, VI, '13 (B.T.E.). Draftsman, United Shoe Machinery Corporation, Beverly, Mass.

Hood, Leslie Newton, IV, '12 (D). Chemist, Union Bleachery, Greenville, S. C.

Hook, Russell Weeks, IV, '05 (D). Textile Chemist, Arthur D. Little, Inc., 30 Charles River Road, Cambridge, Mass.

Hooper, Clarence, IV, '27 (B.T.C.). Overseer of Dyeing, Waynesboro Knitting Company, Waynesboro, Pa.

Horne, James Albert, I, '24 (D). Mill Department, Wellington, Sears & Co., 55 Worth Street, New York City.

Horsfall, George Gordon, II, '04 (C). Assistant Dyer, Interwoven Mills, Inc., Martinsburg, W. Va.

Horton, Chester Temple, VI, '14 (B.T.E.). Wilmington, Mass.

Houghton, Robert Kingsbury, IV, '23 (B.T.C.). Chemist, Cheney Brothers, South Manchester, Conn.

Howarth, Charles Lincoln, IV, '17 (B.T.C.). Assistant Professor of Dyeing, Lowell Textile Institute, Lowell, Mass.
Howe, Woodbury Kendall, I, '10 (D). Assistant Superintendent, Merrimack Manufacturing Company, Lowell, Mass.
Hoyt, Charles William Henry, IV, '07 (D).
Hsu, Hsueh-Chang, VI, '23 (B.T.E.).
Hubbard, Harold Harper, I, '22 (D). Technical Assistant, National Association of Cotton Manufacturers, 80 Federal Street, Boston, Mass.
Hubbard, Ralph King, IV, '11 (D). Treasurer and Manager, Packard Mills, Inc., Webster, Mass.
Huising, Gerónimo Huerva, I, '08 (D). Farmer, Hda "Perseverancia," San José, Mindoro, P. I.
Hunt, Chester Lansing, III, '05 (C).
Hunton, John Horace, II, '11 (D). Melrose, Mass.
Hurtado, Leopoldo, Jr., VI, '10 (D). General Manager, Hurtado & Co., Uruapan, Michoacán, Mex.
Hurwitz, Jacob, IV, '23 (B.T.C.).
Hutton, Clarence, III, '03 (C). Editor, "Textile World," 65 Franklin Street, Boston, Mass.
Hyman, Wolfred, II, '28 (D). 36 Schuyler Street, Roxbury, Mass.

Irvine, James Andrew, VI, '17 (B.T.E.). Manager of Employment and Training, Cheney Brothers, South Manchester, Conn.
Isaacson, George Franklin, II, '26 (D). With Clarence S. Brown & Co., 40 Worth Street, New York City.

Jaeger, Robert William, Jr., IV, '23 (B.T.C.). Research Engineer, Armour & Co., Chicago. Ill.
Jelleme, William Oscar, I, '10 (D). With Pacific Mills, 24 Thomas Street, New York City.
Jen, Shang Wu, I, '21 (D).
Jenckes, Leland Aldrich, VI, '08 (D). Deceased.
Jessop, Charles Clifford, VI, '22 (B.T.E.). Textile Engineer, Pacific Mills, 24 Thomas Street, New York City.
Johnson, Arthur Kimball, IV, '13 (D). (S.B. 1917 Massachusetts Institute of Technology.) Research Chemist, Cheney Brothers, So. Manchester, Conn.
Johnson, George Henry, IV, '20 (B.T.C.). Research, Laundry Owners National Association, La Salle, Ill.
Johnson, Philip Stanley, IV, '24 (B.T.C.). Color Chemist and Sales Manager, Tizian Color Company, 25 Arch Street, Boston, Mass.
Jones, Everett Amos, III, '05 (D). Superintendent and Assistant Secretary, Nye & Wait Kilmarnock Corporation, Auburn, N. Y.
Jones, Nathaniel Erskine, I, '21 (D). Assistant Superintendent, E. L. Watkins, 604 Forest Avenue, Portland, Maine
Joslin, Harold Wheeler, II, '28 (D). Milford, N. H., R.F.D. No. 1.
Joy, Thomas, VI, '26 (B.T.E.). Engineer, Cambridge Rubber Company, Cambridge, Mass.
Jury, Alfred Elmer, IV, '04 (D). Manager, Textile Development, United States Rubber Company, 1790 Broadway, New York City.

Kaatze, Julius, VI, '22 (B.T.E.). Salesman, Toledo Scale Company, Lawrence, Mass.
Kao, Chieh-Ching, VI, '23 (B.T.E.).
Karanfilian, John Hagop, VI, '21 (B.T.E.).
Kay, Harry Pearson, II, '09 (D). Associate Member, Stanford Wright Agency, Penn Mutual Life Insurance Company, Boston, Mass.
Kendall, Charles Henry, II, '23 (D). Superintendent and Designer, Bridgewater Woolen Company, Bridgewater, Vt.
Kennedy, Francis Charles, VI, '26 (B.T.E.). Product Development Department, The Fisk Rubber Company, Chicopee Falls, Mass.

Kenney, Frederick Leo, II, '27 (D). Assistant Designer, Uxbridge Worsted Company, Uxbridge, Mass.

Kent, Clarence LeBaron, III, '06 (C). Agent, Standard Oil Company, Rochester, N. H.

Keough, Wesley Lincoln, II, '10 (D). With E. A. Pierce & Co., Pasadena, Calif.

Killheffer, John Vincent, IV, '28 (B.T.C.). Textile Chemist, Newport Chemical Works, Inc., Greensboro, N. C.

Kingsbury, Percey Fox, IV, '01 (D). Print Manager, Passaic Print Works, Passaic, N. J.

Knowland, Daniel Power, IV, '07 (D). Chemist, Geigy Company, Inc., 89 Barclay Street, New York City.

Knox, Joseph Carleton, VI, '23 (B.T.E.). Assistant Sanitary Engineer, State Department of Health, Boston, Mass.

Kuo, Limao, VI, '26 (B.T.E.).

Lakeman, Fannie Shillaber, IIIb, '00 (C). Died February 8, 1921.

Lamb, Arthur Franklin, II, '10 (D). In business, Cleansing and Dyeing, Rockland, Maine

Lamont, Robert Laurence, II, '12 (D).

Lamprey, Leslie Balch, IV, '16 (B.T.D.). 18 Holton Street, Lawrence, Mass.

Lamson, George Francis, I, '00 (D). With Ludlow Manufacturing Associates, Ludlow, Mass.

Lane, John Williams, I, '06 (C).

Lane, Oliver Fellows, IV, '15 (B.T.D). Chemist, Head of Color Making Department, Lowe Paper Company, Ridgefield, N. J.

Larratt, John Francis, II, '22 (D). With Mohawk Carpet Company, Amsterdam, N. Y.

Laughlin, James Knowlton, III, '09 (D).

Laurin, Eric Thursten Lawrence, IV, '21 (B.T.C.). Superintendent of Dyeing, Bradford Dyeing Association, Bradford, R. I.

Laurin, Sven Albert, IV, '23 (B.T.C.). Student, Boston University, Boston, Mass.

Leach, John Pelopidas, I, '00 (C). Farming, Mosby Hall Farm, Littleton, N. C.

Leavitt, George Herbert, II, '26 (D). Yarn Process Inspector, F. C. Huyck & Sons, Albany, N. Y.

Lee, William Henry, II, '05 (C). Manager, Graves Hall & Co., Inc., New Haven, Conn.

Leitch, Harold Watson, IV, '14 (B.T.D.). Assistant Superintendent, Pacific Mills, Lawrence, Mass.

Lemire, Joseph Emile, VI, '21 (B.T.E.). In Real Estate Business, Lowell, Mass.

Leonard, Leo Edward, I, '27 (D). 115 West Street, Worcester, Mass.

Levi, Alfred Sandel, IV, '09 (D). President, Liondale Bleach, Dye and Print Works, Rockaway, N. J.

Lewis, George Kenneth, VI, '24 (B.T.E.). Junior Engineer, Mechanical Experimental Division, Du Pont Rayon Company, Buffalo, N. Y.

Lewis, LeRoy Clark, IV, '08 (D). Representative, Kananoishi Seishi Kaisha of Kobe, Japan, 79 Madison Avenue, New York City.

Lewis, Walter Scott, IV, '05 (D). Special Expert in Textiles, United States Tariff Commission, Washington, D. C.

Lillis, Marvin Hale, IV, '14 (D). With Marland Mills, Andover, Mass.

Linsey, Edward, II, '25 (D). Production Department, Mohawk Carpet Mills, Inc., Amsterdam, N. Y.

Logan, George Leslie, VI, '28 (B.T.E.). Engineer, Tompkins Brothers Company, Syracuse, N. Y.

Lombard, Carleton Joshua, VI, '23 (B.T.E.). With Curtis & Marble Machine Company, Worcester, Mass.

Loney, Robert William, II, '22 (D). Foreman, General Electric Company, Schenectady, N. Y.

Longbottom, Parker Wyman, IV, '21 (B.T.C.). Chemist and Dyer, Claremont Waste Manufacturing Company, Claremont, N. H.

Lowe, Philip Russell, VI, '24 (B.T.E.). With Factory Mutual Fire Insurance Company, Boston, Mass.

Lucey, Edmund Ambrose, II, '04 (D). Consulting Engineer and Textile Specialist, Edmund A. Lucey & Co., 53 Park Place, New York City.

Lussier, Joseph Adrien, II, '27 (D). Assistant New Goods Aide, Hood Rubber Company, East Watertown, Mass.

McCann, John Joseph, Jr., VI, '24 (B.T.E.).

McCool, Frank Leslie, IV, '10 (D). Vice-President, S. R. David & Co., Inc., 252 Congress Street, Boston, Mass.

Macdonald, Hector Graham, IV, '19 (B.T.C.). Chemist, Franklin Process Company, Providence, R. I.

McDonnell, William Henry, I, '06 (C). Lawyer, McDonnell & White, 40 Court Street, Boston, Mass.

McGowan, Frank Robert, VI, '15 (B.T.E). Textile Engineering Adviser, Cotton-Textile Institute, Inc., 320 Broadway, New York City.

McGowan, Henry Earl, VI, '22 (B.T.E.). Instructor, Lowell High School, Lowell, Mass.

Maguire, James Joseph, II, '28 (D). 4 Dean Court, North Attleboro, Mass.

McGuire, Edward Perkins, VI, '28 (B.T.E.). General Merchandiser, Associated Dry Goods Corporation, 17 East 39th Street, New York City.

Mackay, Stewart, III, '07 (D). Assistant Professor of Textile Design, Lowell Textile Institute, Lowell, Mass.

McKenna, Hugh Francis, IV, '05 (D). Chicago Manager, United Indigo and Chemical Company, Ltd., 218 West Kinzie Street, Chicago, Ill.

McKinstry, James Bradley, II, '25 (D). Superintendent, Millbury Woolen Company, Millbury, Mass.

McKay, Benedict Josephus, IV, '28 (B.T.C.). Chemist, Merrimack Manufacturing Company, Lowell, Mass.

MacPherson, Wallace Angus, III, '04 (D). Designer, Wuskanut Mills, Inc. (S. Slater & Sons), Farnumsville, Mass.

Macher, Henry, II, '23 (D). Industrial Research Work, Botany Worsted Mills, Passaic, N. J.

McKittrick, Raymond Wellington, VI, '28 (B.T.E.). With Johns-Manville Corporation, Manville, N. J.

Mahoney, George Stephen, VI, '22 (B.T.E.). Overseer, Franklin Cotton Mill Company, Cincinnati, Ohio.

Mailey, Howard Twisden, II, '08 (D). Superintendent, Worsted Yarns, Pacific Mills, Lawrence, Mass.

Manning, Frederick David, IV, '10 (D). Planning Department, Pacific Mills, Lawrence, Mass.

Marinel, Walter Newton, I, '01 (D). Automobile Repairing, North Chelmsford, Mass.

Mark, Aris Sawa, VI, '22 (B.T.E.). Sales Department, Overton Textile Company, New York City.

Marshall, Chester Stanley, II, '22 (D). Salesman, Du Pont Rayon Company, 31 North 6th Street, Reading, Pa.

Martin, Harry Warren, IV, '11 (D). Management Department, Hood Rubber Company, Watertown, Mass.

Mason, Archibald Lee, VI, '09 (D). With Merrimack Woolen Company, Dracut, Mass.

Mason, Philip Edwin, IV, '26 (B.T.C.). Salesman and Chemist, Watson Park Company, 470 Atlantic Avenue, Boston, Mass.

Mather, Harold Thomas, VI, '13 (D). Inspector, Associated Factory Mutual Fire Insurance Companies, Boston, Mass.

Mathieu, Alfred Jules, II, '20 (D). Superintendent of Combing, French Worsted Company, Woonsocket, R. I.

Matthews, Elmer Clark, II, '17 (D). Superintendent, Thermo Mills, Inc., West Sand Lake, N. Y.

Mauersberger, Herbert Richard Carl, III, '18 (D). Chief Assistant with James W. Cox, Jr., Textile Engineer, 320 Broadway, New York City.

Mazer, Samuel, IV, '26 (B.T.C.). In business, Wilber Skein Dyeing Company, Hyde Park, Mass.

Meadows, William Ransom, I, '04 (D). Cotton Registrar, Chicago Board of Trade, Chicago, Ill.

Meek, Lotta, IIIb, '07 (C). See Parker, Mrs. Herbert L.

Meeker, Samuel, IV, '27 (B.T.C.). Textile Chemist, Procter & Gamble Co., Paterson, N. J.

Merchant, Edith Clara, IIIb, '00 (C). Art Supervisor, Lowell, Mass.

Merrill, Allan Blanchard, IV, '11 (D). Manager, Development Department, B. F. Goodrich Company, Akron, Ohio.

Merrill, Gilbert Roscoe, VI, '19 (B.T.E.). Professor of Textiles; in charge of Cotton Yarn Department, Lowell Textile Institute, Lowell, Mass.

Merrill, John Leslie, VI. '27 (B.T.E.). Instructor in Weaving, Lowell Textile Institute, Lowell, Mass.

Merriman, Earl Cushing, II, '07 (D). Died September 30, 1918.

Meyers, Chester William, IV, '27 (B.T.C.). Second Hand in Dyehouse, Massachusetts Knitting Mills, Jamaica Plain, Mass.

Midwood, Arnold Joseph, IV, '05 (D). Salesman, Dyestuffs Corporation of America, 281 Franklin Street, Boston, Mass.

Miller, Joshua, VI, '24 (B.T.E.). Assistant Technologist, Bureau of Standards, Washington, D. C.

Minge, Jackson Chadwick, I, '01 (C).

Mirsky, Leon Robert, II, '19 (D). Salesman, New York Machinery Company, New York City.

Mitchell, Charles Alvah, II, '24 (D). Production Department, Mohawk Carpet Mills, Inc., Amsterdam, N. Y.

Moller, Ernest Arthur, II, '22 (D). Salesman, The Goodyear Tire & Rubber Co., Inc., Boston, Mass.

Molloy, Francis Henry, II, '16 (D). Assistant Designer, Assabet Mill (American Woolen Company), Maynard, Mass.

Moore, Edward Francis, II, '25 (D). In Charge of Planning Department, Rockford Mitten and Hosiery Company, Rockford, Ill.

Moore, Everett Byron, I, '05 (D). President, Chadbourne & Moore, Inc., Chelsea, Mass.

Moore, Karl Remick, IV, '11 (D). Assistant Superintendent, Lorraine Manufacturing Company, Pawtucket, R. I.

Moore, William Joseph, IV, '21 (B.T.C.). Colorist, Pacific Mills, Lawrence, Mass.

Moorhouse, William Roy, IV, '01 (D). Sales Manager, National Aniline and Chemical Company, Inc., 40 Rector Street, New York City.

Morrill, Howard Andrew, VI, '16 (D). Assistant Agent, Postex Cotton Mills, Post, Texas.

Morris, Merrill George, IV, '21 (B.T.C.). Chemist, National Aniline & Chemical Co., 40 Rector Street, New York City.

Morrison, Fred Clifton, I, '03 (D). Died August 21, 1919.

Morrison, Haven Asa, IV, '25 (B.T.C.). Chief Chemist, The Barre Wool Combing Company, Ltd., South Barre, Mass.

Mullaney, John Francis, VI, '20 (B.T.E.). Salesman, Saco-Lowell Shops, Newton Upper Falls, Mass.

Mullen, Arthur Thomas, II, '09 (D). Superintendent, Maine Woolen Mills, Inc., Camden, Maine.

Munroe, Sydney Philip, I, '12 (D). Manager, Ralph E. Loper & Co., Greenville, S. C.

Murray, James, IV, '13 (D). With Pawtucket Glazed Paper Company, Pawtucket, R. I.

Murray, James Andrew, II, '10 (D). Chocolate Manufacturer, Murene Chocolate Company, 162 Commercial Street, Boston, Mass.

Najar, G. George, IV, '03 (D). Dyer and Bleacher, Monument Mills, Housatonic, Mass.

Nary, James Anthony, II, '22 (D). Manager, Chicago Testing House, United States Testing Company, Inc., Chicago, Ill.
Nelson, Roy Clayton, II, '21 (C). Designer, Assabet Mills, Maynard, Mass.
Nelson, Russell Sprague, VI, '22 (B.T.E.). Cost Department, Draper Corporation, Hopedale, Mass.
Neugroschl, Sigmond Israel, I, '21 (D).
Newall, John Douglas, IV, '09 (D). Divisional Superintendent, Arnold Print Works, North Adams, Mass.
Newcomb, Guy Houghton, IV, '06 (C). Manager, Philadelphia Office, E. I. du Pont de Nemours & Co., 128 South Front Street, Philadelphia, Pa.
Neyman, Julius Ellis, IV, '15 (B.T.D.). Furniture Dealer, Neyman Furniture Company, 197–199 Middlesex Street, Lowell, Mass.
Nichols, Raymond Elmore, VI, '10 (D). Chief Draftsman, H. E. Fletcher Company, West Chelmsford, Mass.
Niven, Robert Scott, VI, '12 (D). Turbine Drafting Department, General Electric Company, Lynn, Mass.
Nostrand, Mrs. William L. (Conklin, Jennie Grace), IIIb, '05 (C). 35 87th Street, Bay Ridge, Brooklyn, N. Y.

O'Brien, Philip Francis, II, '15 (D). (B.S. New York University, M.A. Fordham University.) Chairman, Textile Department, New York Textile High School, New York City.
O'Connell, Clarence Edward, IV, '11 (D). Dyer, National Aniline and Chemical Company, Buffalo, N.Y.
O'Connor, Lawrence Dennis, VI, '17 (D). With Beggs & Cobb, Winchester, Mass.
O'Donnell, John Delaney, I, '04 (C).
O'Hara, William Francis, IV, '04 (C).
Olson, Carl Oscar, II, '24 (D). Scheduling Department, Cheney Brothers, South Manchester, Conn.
Orr, Andrew Stewart, IV, '22 (B.T.C.). With Cherry & Webb, Lowell, Mass.
Osborne, George Gordon, VI, '28 (B.T.E.). Production and Research Department, Cheney Brothers, South Manchester, Conn.
Othote, Louis Joseph, I, '23 (D). Designer and Styler, T. Holt Haywood Department, 65 Leonard Street, New York City.

Palais, Samuel, IV, '18 (B.T.C.). Assistant Manager, Durrell Company, 1 Beacon Street, Boston, Mass.
Parker, B. Moore, I, '01 (D). Died December 11, 1918.
Parigian, Harold Hrant, IV, '28 (B.T.C.). Research Chemist, Cambridge Rubber Company, Cambridge, Mass.
Parker, Everett Nichols, I, '05 (D). President, Parker Spool and Bobbin Company, 27–53 Middle Street, Lewiston, Maine.
Parker, Harry Carmi, III, '00 (C). 142 Berkeley Street, Boston, Mass.
Parker, Mrs. Herbert L. (Meek, Lotta L.), IIIb, '07 (C). 4 Brookside Circle, Auburn, Maine.
Parker, Hubert Frederic, VI, '20 (B.T.E.). Assistant to Engineer, Castanea Paper Company, Lock Haven, Pa.
Parkin, Robert Wilson, VI, '27 (B.T.E.). Office Manager and Cost Accountant, Limerick Mills, Limerick, Maine.
Parkis, William Lawton, I, '09 (D). Assistant Superintendent, Cheney Brothers, South Manchester, Conn.
Parsons, Charles Sumner, VI, '27 (B.T.E.). Overseer of Carding, Pepperell Manufacturing Company, Biddeford, Maine.
Peabody, Roger Merrill, II, '16 (D). Superintendent, Belamose Corporation, Rocky Hill, Conn.
Pearson, Alfred Henry, IV, '11 (D). Salesman, Ciba Company, Inc., 93 Broad Street, Boston, Mass.
Pearlstein, Maxwell, III, '28 (D). Assistant to Superintendent, Utica Steam & Mohawk Valley Cotton Mills, Mohawk Division, Utica, N. Y.

Pease, Chester Chapin, I, '09 (D). Agent, Columbian Mills (Otis Company), Greenville, N. H.

Peck, Carroll Wilmot, IV, '13 (D). Vice-President, George Mann & Co., Inc., Providence, R. I.

Pensel, George Robert, IV, '13 (B.T.D.). Vice-President, Ritter Chemical Company, Inc., Amsterdam, N. Y.

Perkins, John Edward, III, '00 (D). Superintendent, S. N. & C. Russell Manufacturing Company, Pittsfield, Mass.

Perkins, Joshua Dean, III, '08 (D). Assistant Superintendent, Worsted Dressing, Amoskeag Manufacturing Company, Manchester, N. H.

Perlman, Samuel, IV, '17 (B.T.C.).

Perlmuter, Barney Harold, IV, '23 (B.T.C.). Credit Manager, American Furniture Company, Boston, Mass.

Petty, George Edward, I, '03 (C). With Jefferson Standard Insurance Company, Greensboro, N. C.

Phaneuf, Maurice Philippe, III, '20 (D). Estimator and Draftsman, S. Belanger & Sons, Inc., Nashua, N. H.

Pierce, George Whitwell, IV, '25 (B.T.C.). Assistant Superintendent of Dyeing, Celanese Corporation of America, Cumberland, Md.

Pillsbury, Ray Charles, I, '13 (D). Manager, Manufacturing Standards Department, Cheney Brothers, South Manchester, Conn.

Plaisted, Webster E., II, '18 (D). Superintendent, Rochdale Mills (American Woolen Company), Rochdale, Mass.

Plummer, Elliot Barton, IV, '13 (D). Died January 14, 1919.

Potter, Carl Howard, I, '09 (D). Resident Manager, Green River Manufacturing Company, Tuxedo, N. C.

Pottinger, James Gilbert, II, '12 (D). Piece Goods Buyer, Reliance Manufacturing Company, 212 West Monroe Street, Chicago, Ill.

Powers, Walter Wellington, IV, '20 (B.T.C.). Superintendent, Lacquer Division, Fiberloid Corporation, Indian Orchard, Mass.

Pradel, Alois Joseph, III, '00 (D). Designer, Killingly Worsted Company, Danielson, Conn.

Pradel, Mrs. Alois J. (Walker, Anna G.). IIIb, '03 (C). 78 Broad Street, Danielson, Conn.

Precourt, Joseph Octave, VI, '21 (B.T.E.). Western Sales Manager, Cayuga Linen and Cotton Mills, Inc., 437 West Ontario Street, Chicago, Ill.

Prescott, Walker Flanders, IV, '09 (D). Sales Manager, Prescott & Co., Reg'd, 637 Craig Street, West, Montreal, Can.

Prince, Sylvanus Cushing, VI, '08 (D).

Proctor, Braman, IV, '08 (D). Salesman, General Dyestuff Corporation, 159 High Street, Boston, Mass.

Putnam, George Ives, IV, '16 (B.T.D.). Chief Chemist, McLoughlin Textile Corporation, Utica, N. Y.

Putnam, Leverett Nelson, IV, '10 (D). Overseer of Dyeing, Webster Mills, (American Woolen Company), Webster, Mass.

Putnam, Philip Clayton, IV, '13 (D). Superintendent of Dyeing, Apponaug Company, Apponaug, R. I.

Quinlan, William Harold, VI, '20 (B.T.E.). Research Assistant, Warren Brothers Company, 38 Charles River Road, Cambridge, Mass.

Radford, Garland, II, '20 (D). Manager, Oriental Textile Mills, Houston, Texas.

Ramsdell, Theodore Ellis, I, '02 (D). Vice-President and Agent, Monument Mills, Housatonic, Mass.

Rasche, William August, III, '03 (D). Deceased.

Raymond, Charles Abel, IV, '07 (D). Superintendent, New England Fuel and Transportation Co., Everett, Mass.

Redding, Leslie Capron, II, '26 (D). Assistant Designer, Saranac Mills, Blackstone, Mass.

Reed, Norman Bagnell, I, '10 (D). President and Treasurer, Lowell Mills Company, Lowell, Mass.

Reinhold, Kurt Herman, VI, '28 (B.T.E.). Special Representative, Russell Manufacturing Company, Atlanta, Ga.

Reynolds, Fred Bartlett, II, '08 (D). Purchasing Agent, M. T. Stevens & Sons Company, North Andover, Mass.

Reynolds, Isabel Halliday, III, '03 (C). Clerk, Pacific Mills Print Works, Lawrence, Mass.

Reynolds, Raymond, II, '24 (D). With Silesia Mills, North Chelmsford, Mass.

Rice, Josiah Alfred, Jr., III, '20 (D). Assistant Manager, Wholesale Ginghams & Wool Goods, Marshall Field & Co., Chicago, Ill.

Rich, Edward, IV, '15 (B.T.D.). Merchant, Jackson Caldwell Company, East Boston, Mass.

Rich, Everett Blaine, III, '11 (D). Onacove-Sewall Road, Wolfeboro, N. H.

Rich, Milton Scott, II, '22 (D). With Riverina Mills, Medford Hillside, Mass.

Richardson, George Oliver, IV, '16 (B.T.D.). Manager, Tientsin Office, National Aniline and Chemical Company, U. S. A., Tientsin, China.

Richardson, Richardson Perry, I, '13 (D). Salesman, H. F. Livermore Company, Boston, Mass.

Riggs, Homer Chase, VI, '17 (B.T.E.). Sales Engineer, Rodney Hunt Machine Company, Orange, Mass.

Ripley, George Keyes, II, '17 (D). Superintendent, Troy Blanket Mills, Troy, N. H.

Rivers, William Anthony, II, '24 (D). Superintendent, Nantanna Worsted Company, Northfield, Vt.

Roberson, Pat Howell, I, '05 (C). Merchant, James R. Roberson & Sons, Cropwell, Ala.

Roberts, Carrie Isabel, IIIb, '05 (C). Craft Work, 37 Grace Street, Lowell, Mass.

Robinson, Ernest Warren, IV, '08 (D). Silk Department Manager, J. & P. Coats, Inc., Pawtucket, R. I.

Robinson, Russell, VI, '21 (B.T.E.). Assistant Textile Superintendent, Celanese Corporation of America, Amcelle, Md.

Robinson, William Albert, II, '25 (D). 26 Chauncy Street, Suite 5, Cambridge, Mass.

Robinson, William Carleton, III, '03 (C). With American Wool and Cotton Reporter, 530 Atlantic Avenue, Boston, Mass.

Robson, Frederick William Charles, IV, '10 (D).

Roche, Raymond Vincent, IV, '12 (D). Died September 10, 1926.

Rodalvicz, Francis Rudolph, IV, '28 (B.T.C.). Chemist, American Woolen Company, Andover, Mass.

Royal, Louis Merry, VI, '21 (B.T.E.). Principal, Charlemont High School, Charlemont, Mass.

Rundlett, Arnold Dearborn, VI, '12 (D). Superintendent, Joseph Noone's Sons Company, Peterborough, N. H.

Runnells, Harold Nelson, IV, '25 (B.T.C.). Textile Chemist, Thermo Mills, Inc., West Sand Lake, N. Y.

Russell, John William, IV, '20 (B.T.C.). Superintendent, Lawrence Dye Works, United States Worsted Corporation, Lawrence, Mass.

Russell, William Samuel, Jr., VI, '28 (B.T.E.). With Johns-Manville Corporation, Manville, N. J.

Ryan, David Louis, II, '27 (D). Sales Representative, American Glanzstoff Corporation, Lafayette Building, Philadelphia, Pa.

Ryan, Lawrence Francis, IV, '23 (B.T.C.). Chemist, Pacific Mills, Lawrence, Mass.

Ryan, Millard Kenneth Thomas, Jr., II, '24 (D). Assistant Manager, Shanghai International Testing House, Shanghai, China.

Sampson, Clifford William, IV, '28 (B.T.C.). Chemist, Boston Blacking Company, Boston, Mass.

Sanborn, Frank Morrison, VI, '19 (B.T.E.). Assistant Superintendent, American Net & Twine Co., West Kennebunk, Maine.

Sanborn, Ralph Lyford, VI, '16 (B.T.E.). Timekeeper and Production Clerk, Manville Jenckes Company, Gastonia, N. C.
Sandlund, Carl Seth, VI, '25 (B.T.E.). Research Department, McCallum Silk Hosiery Company, Northampton, Mass.
Sargent, Robert Edward, IV, '25 (B.T.C.). Chemist, Amory, Brown & Co., 88 Broad Street, Boston, Mass.
Sargent, Walter Ambrose, I, '22 (D). Instructor, Textile Shop Practice, Public Schools, Passaic, N. J.
Saunders, Harold Fairbairn, IV, '09 (D). With Sherwin Williams Company, Chicago, Ill.
Savery, James Ryan, II, '23 (D). 1514 Engracia Avenue, Torrance, Calif.
Sawyer, Joseph Warren, IV, '15 (B.T.D.). Died May 6, 1926.
Sawyer, Richard Morey, VI, '27 (B.T.E.). Student, Massachusetts Institute of Technology, Cambridge, Mass.
Scanlon, Andrew Augustine, IV, '26 (B.T.C.). 61 Salem Street, Lawrence, Mass.
Schaetzel, André Paul, IV, '21 (B.T.C.). Chemist, Associated Dyeing & Printing Corporation, Paterson, N. J.
Schneiderman, Jacob, III, '27 (D). Radio Salesman and Expert, "The Radio Shack," 16–19 Brattle Street, Boston, Mass.
Schreiter, Ehrich Ernest Max, VI, '26 (B.T.E.). Buyer, W. R. Grace & Co., 7 Hanover Square, New York City.
Schwarz, Herman Louis, IV, '22 (B.T.C.). Color Chemist, Sandoz Chemical Works, Inc., 710 Washington Street, New York City.
Scott, Gordon Maxwell, IV, '20 (B.T.C.). Chemist, Holden-Leonard Company, Bennington, Vt.
Shaber, Hyman Jesse, VI, '17 (B.T.E.). (M.B.A., 1922, Harvard University.) With Abraham & Straus, Inc., Brooklyn, N. Y.
Shanahan, James Edward, II, '22 (D). Manager, Hygeia Ice & Coal Company, Amsterdam, N. Y.
Shananquet, Mrs. Lee (Woodies, Ida A.), IIIb, '00 (C). Occupational Therapist, Sunshine Sanatorium, Grand Rapids, Mich.
Shea, Francis James, II, '12 (D). Clerk, Corticelli Silk Company, Florence, Mass.
Shea, John Francis, IV, '28 (B.T.C.). Salesman, L. W. Cronkhite, Inc., Boston, Mass.
Shedd, Jackson Ambrose, III, '28 (D). Salesman, Hungerford & Terry, Inc., Boston, Mass.
Shenker, Nahman, III, '25 (D).
Sidebottom, Leon William, IV, '11 (D). Colorist, Boston Blacking Company, Inc., East Cambridge, Mass.
Sjostrom, Carl Gustof Verner, Jr., III, '17 (D). Designer, Pontoosuc Woolen Mills, Pittsfield, Mass.
Slamin, Alfred Francis, I, '26 (D). Research Department, Nashua Manufacturing Company (Suffolk Mills), Lowell, Mass.
Sleeper, Robert Reid, IV, '00 (D). Textile Colorist, Calco Chemical Company, Bound Brook, N. J.
Smith, Albert Adams, I, '99 (D). Deceased.
Smith, Allen Batterman, I, '26 (D). Assistant Superintendent, Maverick Mills, East Boston, Mass.
Smith, Doane White, II, '10 (D). 15 Oakland Street, Natick, Mass.
Smith, Frank Kenfield, II, '24 (D). Research, Belding-Heminway Company, Northampton, Mass.
Smith, Herbert Jeffers, VI, '22 (B.T.E.). Overseer of Ring Spinning, Potter Fine Spinners, Inc., Pawtucket, R. I.
Smith, Ralston Fox, I, '04 (C). Sales Manager, W. H. Warner & Co., 1708 Union Trust Building, Cleveland, Ohio.
Smith, Roger Dennis, II, '27 (D). 131 Portland Street, Haverhill, Mass.
Smith, Stephen Eaton, I, '00 (D). Died May 10, 1926.
Smith, Theophilus Gilman, Jr., IV, '10 (D). Farming, Groton, Mass.
Smith, William Charles, IV, '26 (B.T.C.). Research Associate, American Association of Textile Chemists & Colorists, Bureau of Standards, Washington, D. C.

Snelling, Fred Newman, II, '03 (D). With the American Railway Express Company, Haverhill, Mass.
Sokolsky, Henry, VI, '17 (B.T.E.). Industrial Engineer, B. F. Sturtevant Company, Hyde Park, Mass.
Somers, Benjamin, II, '25 (D). Wool Broker and Dealer, 184 Summer Street, Boston, Mass.
Southwick, Charles Hudson, IV, '22 (B.T.C.). Boss Dyer, Fairmount Dye Works, Woonsocket, R. I.
Spiegel, Edward, II, '03 (C). Theatrical Business, New York City.
Standish, John Carver, IV, '11 (D). Superintendent, Albany Felt Company, Albany, N. Y.
Stass, John George, II, '27 (D). Assistant Styler, Amory, Browne & Co., 64 Worth Street, New York City.
Steele, Everette Vernon, IV, '24 (B.T.C.). Purchasing Agent, Rohm & Haas Co., Inc., Philadelphia, Pa.
Stevens, Dexter, I, '04 (D). Vice-President and Manager, Esmond Mills, Esmond, R. I.
Stevens, Raymond Russell, IV, '19 (B.T.C.). Overseer of Dyeing, The Felters Company, Inc., Millbury, Mass.
Stevenson, Murray Reid, III, '03 (C).
Stewart, Arthur Andrew, II, '00 (D). Professor of Textiles; in charge of Finishing Department, Lowell Textile Institute, Lowell, Mass.
Stewart, Walter Lawrence, III, '03 (D).
Stiegler, Harold Winfred, IV, '18 (B.T.C.). (M.S., 1922, Ph.D., 1924, Northwestern University). Research Work, Cheney Brothers, South Manchester, Conn.
Stohn, Alexander Charles, III, '06 (C). General Superintendent, Carl Stohn, Inc., Hyde Park, Mass.
Stone, Ira Aaron, IV, '09 (D). Vice-President, Royal Manufacturing Company, Charlotte, N. C.
Storer, Francis Everett, II, '07 (D). With Windham County National Bank, Danielson, Conn.
Storey, Alvin Briggs, VI, '28 (B.T.E.). Textile Engineer, Belding-Heminway Company, Belding, Mich.
Stott, John Smith, III, '28 (D). Assistant Designer, Pacific Mills, Lawrence, Mass.
Stronach, Irving Nichols, IV, '10 (D). With Hampton Company, Easthampton, Mass.
Strout, Kenneth Edward, III, '28 (D). Designer, American Mills Company, Waterbury, Conn.
Stursberg, Paul William, II, '07 (D). Died in 1913.
Sturtevant, Albert William, IV, '17 (D). Mechanic, Sturtevant's Repair Shop, 38 Brookside Street, Lowell, Mass.
Sturtevant, Fred William, IV, '26 (B.T.C.). Chemist, Better Fabrics Testing Bureau, 225 West 34th Street, New York City.
Suhlke, Waldo Eric, IV, '20 (B.T.C.). 7 Banks Street, Waltham, Mass.
Sullivan, John David, VI, '12 (D). With Robert Gair Company, Bradford, Mass.
Sullivan, Lambert William, II, '23 (D). Main Street, Groton, Mass.
Sullivan, Willard David, II, '23 (D). 39 Loring Street, Lowell, Mass.
Sunbury, Herbert Ellsworth, VI, '18 (B.T.E.). Mill Manager, Asbestos Spinning & Weaving Corporation, Waterford, N. Y.
Sutcliffe, Henry Mundell, II, '25 (D). Overseer, Uxbridge Worsted Company, (Granite Mills), Pascoag, R. I.
Sutton, Leslie Emans, I, '17 (D). Superintendent, Anniston Cordage Company, Anniston, Ala.
Swain, Harry LeRoy, Jr., I, '26 (D). Manager, Cotton and Fabric Department, Firestone Tire & Rubber Co., Akron, Ohio.
Swan, Guy Carleton, II, '06 (D). Chemist in charge of Imports, United States Department of Agriculture, 201 Varick Street, New York City.
Swanson, John Harold, I, '28 (D). Designer, Georgia Kincaid Mills, Griffin, Ga.

Sweeney, George Hamilton, II, '24 (D). Salesman, Walker Stetson Company, 157 Essex Street, Boston, Mass.
Sweet, Arthur Dutcher, VI, '21 (B.T.E.). Died January 27, 1927.
Swift, Edward Spooner, S. J., I, '02 (D). Clergyman, Church of the Immaculate Conception, Boston, Mass.
Sylvain, Charles Emile, VI, '13 (D). Resident Engineer, Saco-Lowell Shops, and Textile Engineer for International Machinery Company, Rua S. Pedro, 66, Rio de Janeiro, Brazil.
Syme, James Francis, II, '00 (D). With Mohawk Carpet Mills, Inc., Amsterdam, N. Y.
Symmes, Dean Whiting, IV, '22 (B.T.C.). Chemist and Demonstrator, National Aniline and Chemical Company, 27 Lewis Wharf, Boston, Mass.
Tarpey, Thomas Joseph, IV, '27 (B.T.C.). Textile Chemist, Procter & Gamble, Cincinnati, Ohio.

Tarshis, Elias Aaron, IV, '28 (B.T.C.). Assistant Dyer, Gotham Silk Hosiery Company, Inc., New York City.
Teague, Charles Baird, II, '26 (D). Winchester, Mass.
Thaxter, Joseph Blake, Jr., II, '12 (D). Salesman, Ludlow Sales Corporation, 80 Federal Street, Boston, Mass.
Thomas, Roland Vincent, I, '05 (C).
Thompson, Arthur Robert, Jr., IV, '22 (B.T.C.). Southern Manager, Rohm & Haas Company, Inc., 1109 Independence Building, Charlotte, N. C.
Thompson, Everett Leander, I, '05 (D). Salesman, Gulf Refining Company, Park Square Building, Boston, Mass.
Thompson, Henry James, IV, '00 (D). Dyer, United States Rubber Company, Malden, Mass.
Tilton, Elliott Thorp, II, '99 (D). Died January, 1917.
Todd, Walter Ernest, III, '23 (D). Night Superintendent, Stanley Woolen Company, Uxbridge, Mass.
Toepler, Carl, IV, '22 (B.T.C.). Plant Chemist, Bellman Brook Bleachery Company, Fairview, N. J.
Toovey, Sidney Ernest, II, '04 (C). Deceased.
Toshach, Reginald Alexander, II, '11 (D). Assistant Superintendent, M. T. Stevens & Sons Company (Pentucket Mills), Haverhill, Mass.
Toupin, Stephane Frederick, VI, '24 (B.T.E.). Surveyor, Canadian National Railways, Land Survey Department, Montreal, Canada.
True, William Clifford, II, '22 (D). With Chelsea Fiber Mills, Brooklyn, N. Y.
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A STUDY OF THE TENSION IN YARNS DURING SPINNING

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The purpose of this paper is to present the character, scope and results of certain experiments which have been conducted in the laboratories of the Lowell Textile Institute during the past three years for the purpose of making a preliminary study of the tension in yarns during spinning. The material described and presented herewith has been prepared from three theses performed under the direction of the Textile Engineering Department by Louis Goldenburg, 1927, Lawrence W. Gottschalk, 1928, and Kenneth E. Rice, 1929, during their Senior year and as a requirement for the degree of Bachelor of Textile Engineering.

These studies were made with a device whose design is the invention of the writer. Each year has seen some improvements made upon it and finally an autographic attachment was combined with it, so that it might be possible to obtain a permanent record of the variations in the tension. This instrument both indicates and records continuously comparable measures of the instantaneous tension in the yarn at the point where it passes through the yarn guide, or pigtail, of a cotton ring spinning frame or thro the porcelain poteye in the thread board of a worsted cap spinning frame. It is equally adaptable to the measurement of the tension in the strand in the several cotton and worsted roving operations but lack of time up to the present date has prevented a detailed study in this field.

Cotton Ring Spinning.

The larger portion of the time has been devoted to the study of the cotton ring spinning operation with a view to determining the effect upon tension of (a) the size of the traveler (b) the shape of the point of the traveler (c) the size or fullness of the bobbin, and finally (d) to determine if there is any relation between the strength of the yarn and the tension during spinning.

To study the effect of the weight and shape of travelers, identical conditions were maintained during the spinning of a 17's yarn except that both round and square point travelers of numbers 2/0 to 5 inclusive were substituted in succession. Each traveler was run a sufficient length of time before readings were taken to insure that it was well broken in, for it was distinctly noticeable that the tension produced by a new traveler was higher that its final normal value. Studies were made through the medium of record strips like the typical ones reproduced in Figures 1 and 2, and from data taken on individual traverses of the rail, plots of which are shown in Figure 3. These tests were conducted on both warp and filling winds, using a 7″ traverse in the case of the former and a 2″ traverse for the latter, fast up and slow down.

Figure 1 shows a portion of three record strips which indicate the variation in tension for two complete cycles of the rail (four traverses) starting at the bottom position. (These strips are to be read from right to left). In illustrations A, B and C, the filling wind is shown using round point travelers of light, medium and heavy weight respectively. Figure 2, in like manner, shows typical records for one traverse with warp wind and square point travelers. Figure 3 is a reproduction of some plots of tension readings for a single cycle against rail position. For the filling wind, readings were taken as the rail passed the top, one-third, two-thirds, and bottom position on the down traverse, and at the mid-point on the up traverse. For the warp wind, the readings were taken at 1″ intervals on both the down and up traverse. The arrows indicate the direction of movement of the rail.

To correlate, if possible, the strength of yarn to the tension under which it was spun, single strand strength tests were made of the yarn spun with

the different travelers. These tests were made according to the A. S. T. M. specifications and after proper conditioning of the yarn in a standard atmosphere, 65% R. H. at 70°F. The counts of these yarns were also determined so that corrections of strength might be made for variations in size.

From the data thus accumulated certain facts were brought out which serve to verify much of the practical spinner's theory regarding tensions and which permit a quantitative comparison of them. Some of the important generalizations follow with brief comments or discussion where it seems advisable.

1. The first fact with which one is impressed is the variation in tension which occurs in a single traverse. This is due to two causes; first, that due to the centrifugal force of the increasing material in the balloon strand as the rail descends. This causes an increase in tension which is naturally most marked in the case of the warp wind as can be readily seen by comparing the records of Figure 2 with those of Figure 1, and its increase and subsidence is fairly regular and uniform in occurence. The second cause of variation is that due to small inequalities in the roving from which the yarn is being spun. It is apparently these small variations in the density of the material in the balloon strand which causes the increasing waviness of the records in Figures 1 and 2 as the bottom of the traverse is approached. These same variations are of course present when the rail is near the top of the traverse but it is obvious that because of the decrease in both the radius and length of the balloon their centrifugal force is considerably smaller and hence the record is smoother. It should be understood that the variations due to the second cause are minor and do not affect the main trend of the tension line.

2. It follows from the above that there is less variation in tension during one traverse of filling wind than during one traverse of warp wind. This is brought out clearly by a comparison of the plots in the lower half of Figure 3 with those in the upper half.

3. Furthermore it was found that the average tension during the building of the full warp wind bobbin was 52% higher than that for the filling wind bobbin. The extreme range in tension for the warp bobbin was 200 grains while that for the filling bobbin was 145 grains, or about 70% of the former. Therefore, the inference to be drawn is that the filling wind yields a lower and more uniform tension than warp wind.

4. The tension during the up traverse very closely parallels that of the down traverse although the data seems to indicate a tendency for the former to exceed the latter slightly. It makes no appreciable difference, therefore, so far as tension is concerned whether the binder traverse is laid up or down.

5. In the case of the warp wind the tension at the bottom of the traverse always exceeds that at the top averaging for the entire bobbin 45% excess over the latter. Top and bottom tensions both remain fairly uniform during the entire build of the package.

6. In the case of the filling wind the relationship expressed in number 5 does not seem to hold. The tension at the bottom of traverses as the bobbin is filled decreases definitely at a regularly decreasing rate as might be expected from the diminishing size of the balloon. The tension at the top of traverses on the other hand for the first half of the package is less than that at the bottom, while for the second half it is considerably greater.

7. The effect upon tension of varying the weight of the travelers is shown in the following table.

	Warp Wind		Filling Wind	
Traveler	Sq. Pt.	Rd. Pt.	Sq. Pt.	Rd. Pt.
2/0	317	370	153	149
1/0	276	364	165	159
1	322	375	180	162
2	328	375	183	207
3	358	414	229	209
4	426	427	277	244
5	473	455	286	272

This gives the average tension in grains for two consecutive cycles for both kinds of wind and for both round and square point travelers. The increasing tension for increase in traveler weight is plainly seen by reading down any vertical column. The difference between the round and square point under like conditions is not so consistent. In filling wind the round point gives a smaller tension while the reverse is true in warp wind. This matter needs further study.

The effect of heavy travelers can be clearly visualized from Figures 1 and 2. As mentioned before, the record does not show such sudden and abnormal changes as do those of the light travelers. This is because they are heavy

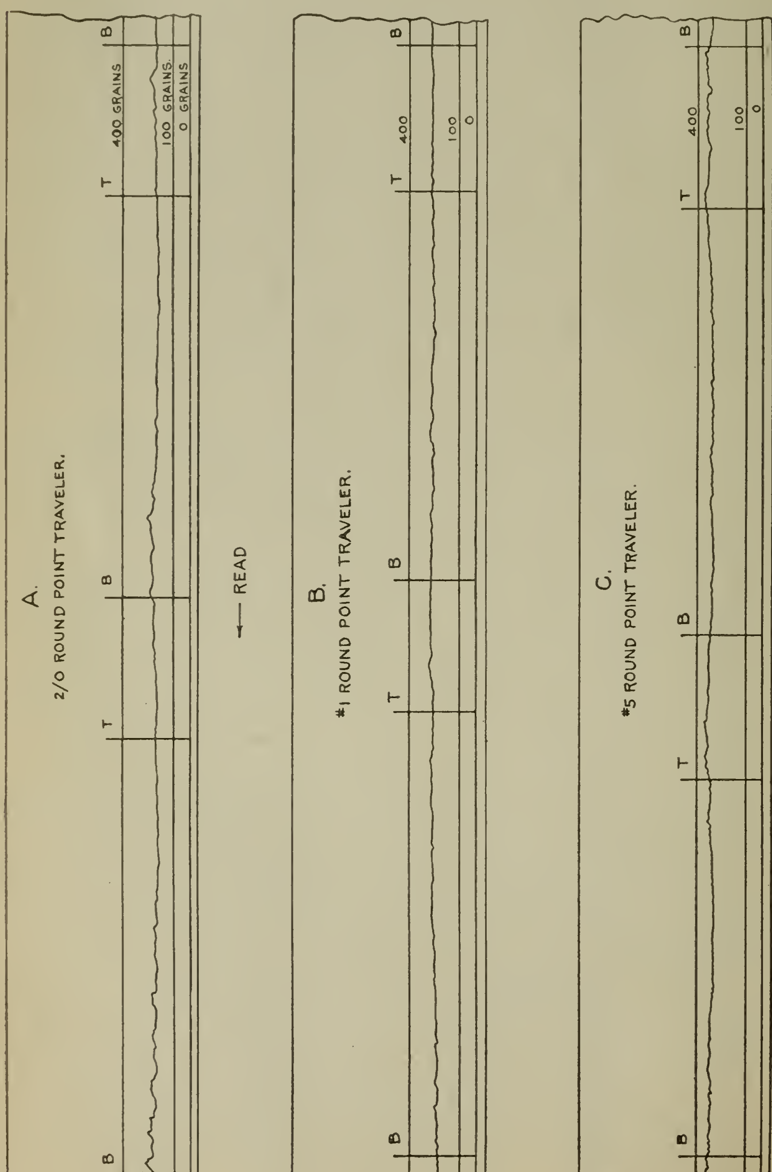


FIG. 1. TYPICAL RECORDS OF TENSION IN FILLING WIND.

T — Top of Traverse. B — Bottom of Traverse.

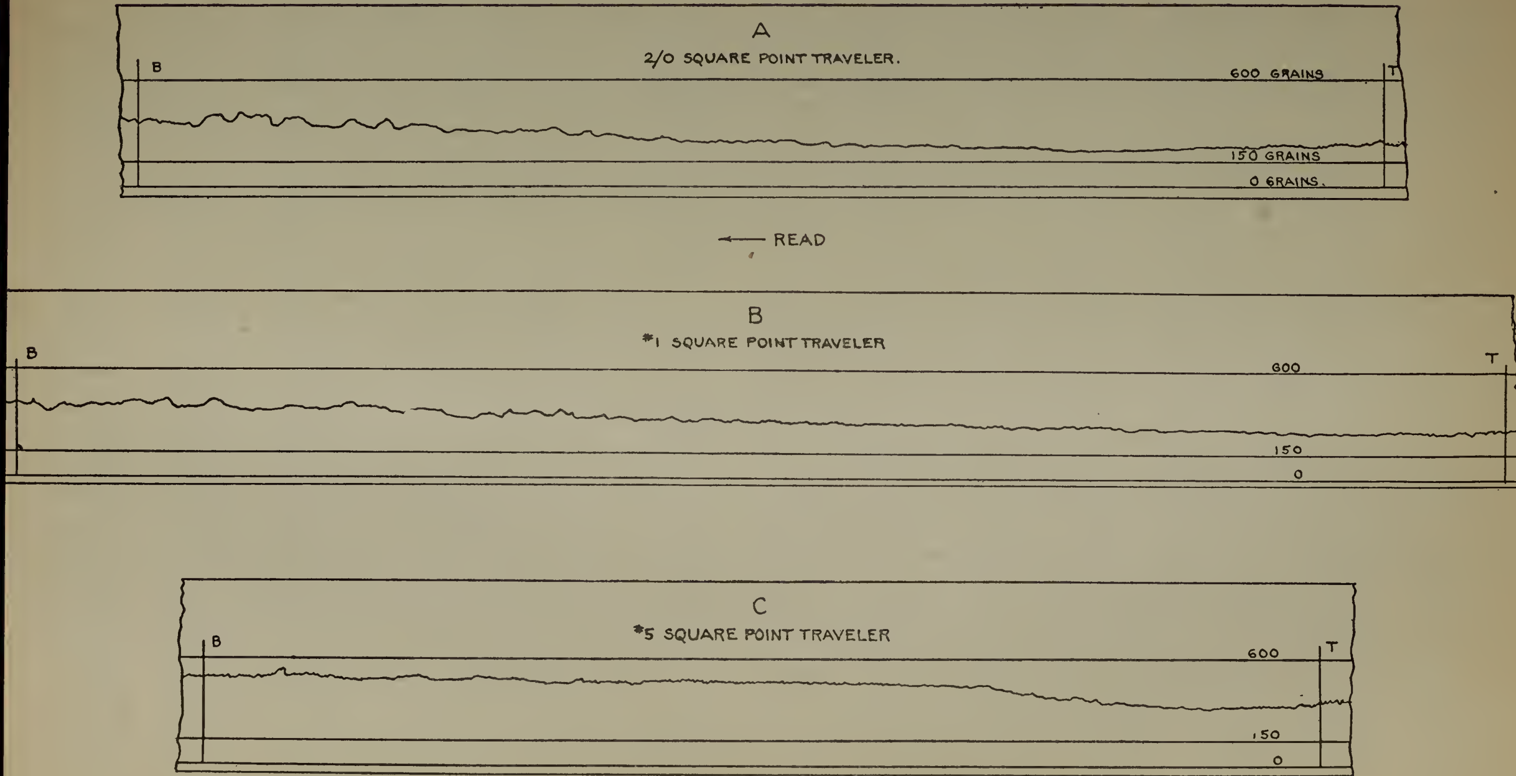


FIG. 2. TYPICAL RECORDS OF TENSION IN WARP WIND.

T — Top of Traverse. B — Bottom of Traverse.

enough to control the centrifugal action of the balloon by preventing its sudden swelling because of a heavy place or slub in the roving.

8. In regard to the effect of tension upon the strength of the yarn, a study of the data made available by these theses and from another source seems to indicate increasing strength with increasing tension.

Worsted Cap Spinning.

The remainder of the time has been devoted to the study of the worsted cap spinning operation and one thesis has been performed to secure data for determining the effect upon tension of (a) the diameter of the bobbin, (b) the kind of wind, (c) the size of the yarn, and (d) the type of cap.

Two counts of yarn were spun during the tests, a 22's and 36's, both made from suitable roving. The caps used were of three types, straight, cone, and bell mouth. In the case of all tests made with the straight cap, a double headed warp bobbin was used whose barrel diameter was 1 1/8″. In all the tests with the cone and bell mouth caps, a filling bobbin was used with a barrel diameter of 13/16″.

Three positions of the spindle rail were experimented with, a high, normal, and low position. The high position was 3/4″ above the normal and the low position 1 1/2″ below normal. With the rail in normal position, the bottom edge of the cap was 8″ below the poteye vertically. Throughout the tests in which this was the sole variable, only the warp wind and straight cap was used. In the study of filling wind, both counts of yarn were used with the three types of caps in normal positions, and with the straight cap at three different levels.

Readings of the tension were taken at the top, middle, bottom, middle, and top or the traverse of the bobbin rail. They were recorded for every other cycle during the build of the full package and always started at the top of the traverse. The same procedure was used in warp and filling wind save that the readings in the case of the latter were not begun until after the butt had been built. In performing the tests care was taken to allow only one factor to vary at a time and from these comparative tests the following facts were noted.

To assist in the presentation and interpretation Figures 4 and 5 have been prepared wherein are plotted the average of the tensions throughout the wind taking positions at the top (T), middle (M) and bottom (B) for every other complete cycle during the entire build of the bobbin. It will be noted in these figures that the up traverse is plotted as a continuation of the down traverse instead of in the reverse manner used in Figure 3. This is done to prevent the superposition of points and lines in the case of symmetrical data.

1. The character of the variation of tension in any one traverse in the filling wind is well illustrated by the series of curves of Figure 4. They all exhibit a regular and characteristic decrease in tension as the winding diameter increases and practically a similar and parallel increase as the winding diameter decreases. This is true whether the spindle rail is in a high, normal or low position. These variations in tensions indicate the effect of variations in the following factors, first, the winding diameter, second, the mass and length of the balloon. The diameter ratio was found to be 1.9 to 1 while the tension ratio varied from 1.3 to 1 to 1.7 to 1. This difference is therefore a measure of the effect of the mass and length of the balloon.

Examination of the changes in tension in a warp wind traverse, Figure 5, leads to the general conclusion that the tension is practically constant throughout the up and down traverses.

2. There is a tendency apparent during the build of a warp bobbin for the individual traverse tensions to decrease slightly with increase in diameter of the package. This seems to be in agreement with the general conclusion in number 1.

3. To determine the effect of size of yarn upon tension a comparison was made of the average tension in spinning a full warp bobbin of 22's, using a straight cap in normal position, with the corresponding figure for 36's. The

ratio of tension of the 22's to the 36's was found to be 2.0 to 1. The corresponding ratio for filling wind is 2.2 to 1. A study of the same ratio for other conditions of spinning shows the ratio varying from a minimum of 1.8 to 1 to a maximum of 2.8 to 1. In this connection it may be noted that the ratio of the weights of equal lengths of 22's and 36's yarns is 1.6 to 1, or the tension ratio is at least 22% greater than the weight ratio under normal conditions of spinning. Since theoretically the centrifugal force is proportional to the weight, this would indicate the magnitude of the effect of another factor, probably the difference in the projected areas of the balloon strand. Computation shows the area of the 22's to be 28% greater than that of the 36's which seems to substantiate the above supposition.

4. Comparison of the effect of kind of wind shows that the filling wind gives a larger average tension that the warp wind. In the case of the 22's it was 24% greater but only 9% greater for the 36's. Thus warp wind produces not only more uniform but also less tension than filling wind.

5. The data secured on filling with cone and bell mouth caps is directly comparable because the same bobbin was used with each as pointed out above. The cone cap produced a heavier tension than the bell mouth in both cases, being 12% greater for the 22's and 38% larger for the 36's. If comparision is made between the straight cap with its larger barreled bobbin and the cone and bell mouth caps, it is found that its tension lies between the other two and nearer to that of the bell mouth, particularly in the case of the lighter yarn.

6. The changes in spindle rail position were made to study the effect upon tension of changes in the vertical component of the length of the balloon and to determine whether the tension changes were proportional to the increased material in the balloon strand. Expressing the tension when the spindle rail is in normal position as 100%, the results of the changes are shown in the following table.

	Spindle Rail Position		
	High	Normal	Low
Warp wind, 22's	85	100	175
Warp wind, 36's	87	100	122
Filling wind, 22's	93	100	142
Filling wind, 36's	82	100	140
Strand length	91	100	119

In computing strand length ratios it is assumed that the balloon strand was increased or decreased in length by the amount of the change in position of the spindle rail. The actual change is slightly more than this due to the curvature of the balloon and if correction were made it would tend to give a little closer agreement. The comparison at best leaves much to be desired, however, and will warrant further experimentation and study. The table will serve a present purpose by giving a good idea of the magnitude of the change in tension for displacements of the spindle rail 3/4" above and 1 1/2" below normal, respectively.

As stated at the beginning of this paper, the data and facts here presented are the results of preliminary studies upon this topic. It is planned to continue these studies further and to correlate the data secured with a mathematical analysis of the mechanics of yarn spinning.

FIG 3

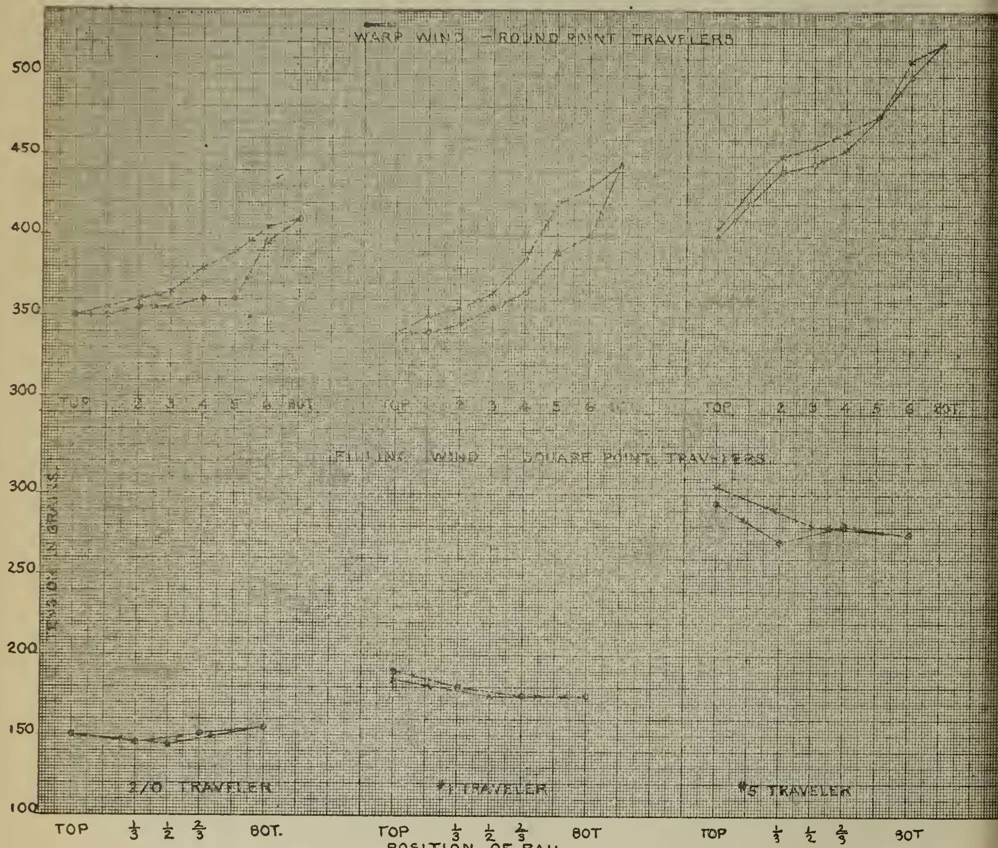

WARP WIND — ROUND POINT TRAVELERS
FILLING WIND — SQUARE POINT TRAVELERS
TENSION IN GRAINS
500
450
400
350
300
300
250
200
150
100
TOP 2 3 4 5 6 BOT.
TOP 2 3 4 5 6
TOP 2 3 4 5 6 BOT
2/0 TRAVELER
#1 TRAVELER
#5 TRAVELER
TOP 1/3 1/2 2/3 BOT.
TOP 1/3 1/2 2/3 BOT
TOP 1/3 1/2 2/3 BOT
POSITION OF RAIL

FIG. 4

POSITION OF RAIL.

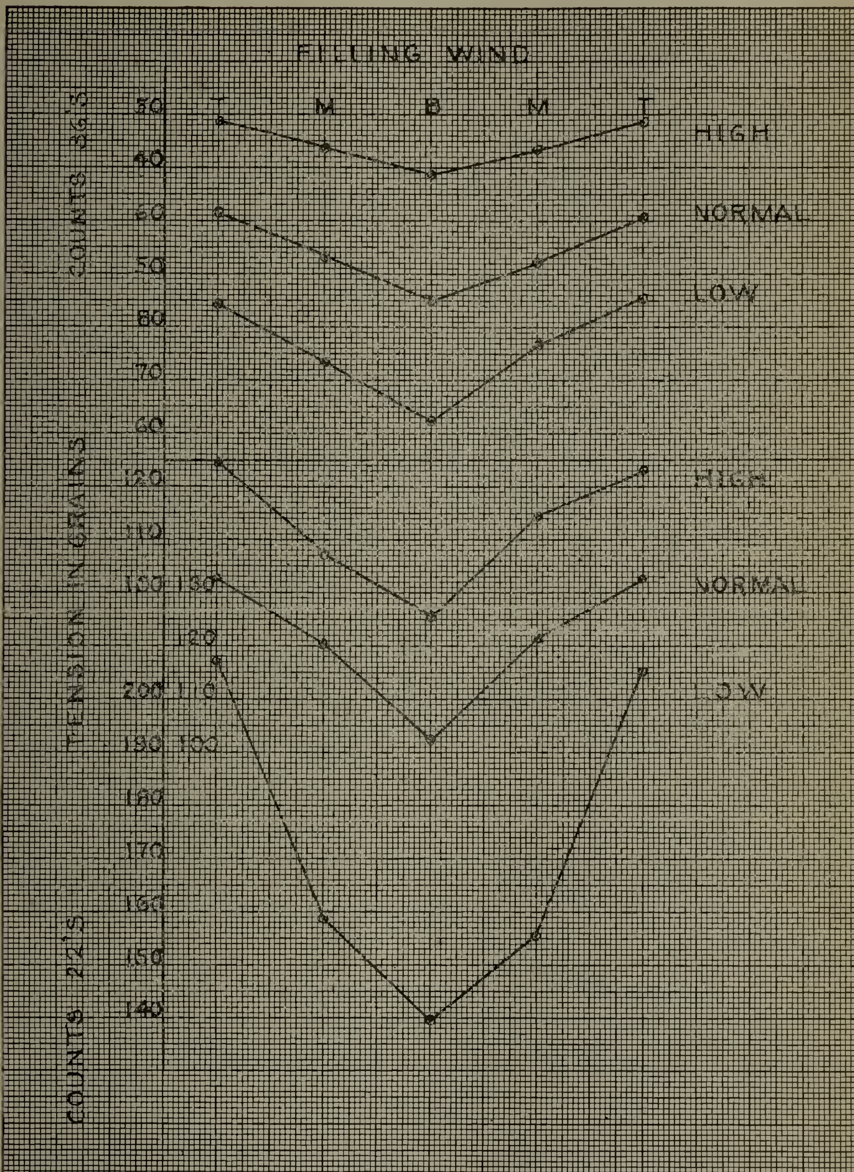
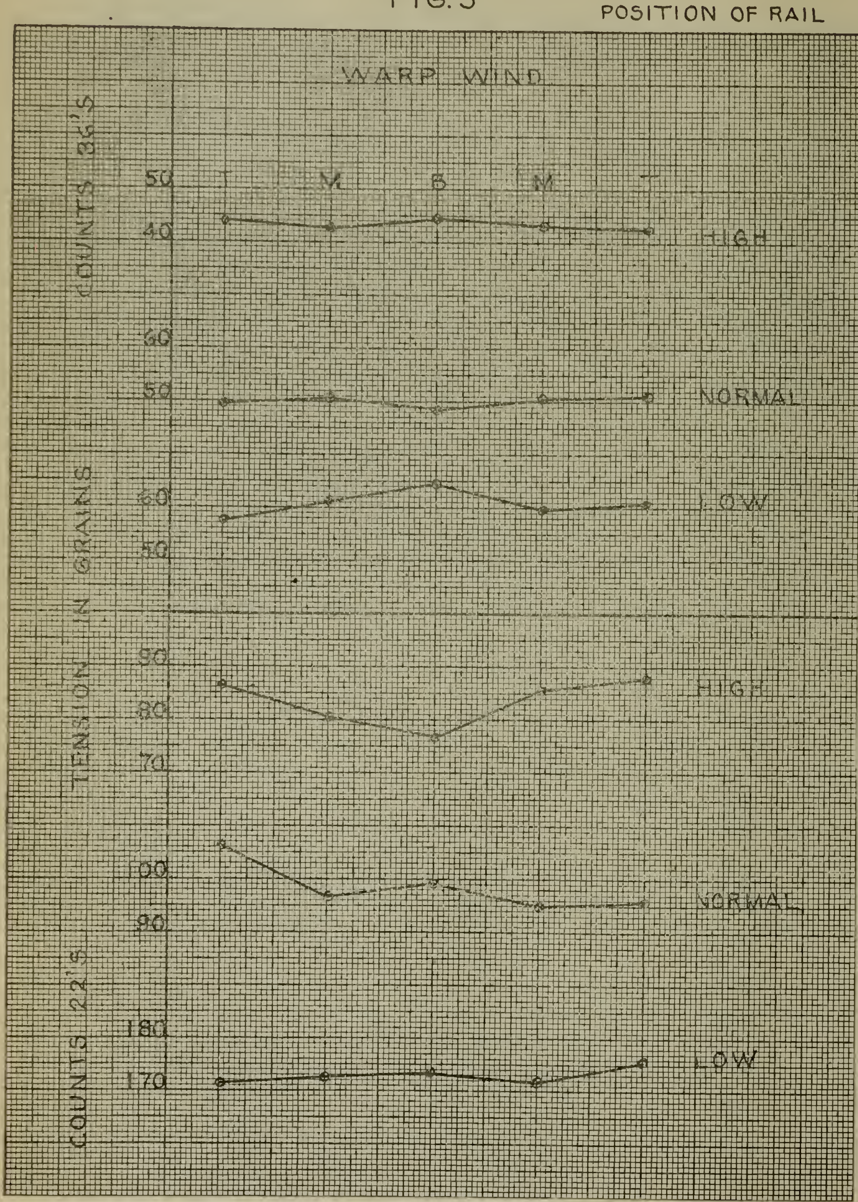


FIG. 5


POSITION OF RAIL
WARP WIND
T
M
B
M
T
COUNTS 36'S
TENSION IN GRAINS
COUNTS 22'S
50
40
60
50
60
50
90
80
70
100
90
180
170
HIGH
NORMAL
LOW
HIGH
NORMAL
LOW

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DEPARTMENT OF LOWELL EVENING TEXTILE SCHOOL

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2,000-8-'29. Order 6483

LOWELL EVENING TEXTILE SCHOOL.

By Act of the Legislature of 1928, the name of the Lowell Textile School was changed to Lowell Textile Institute, and the evening classes are organized and are to be hereafter operated as a department of the Institute to be known as the Lowell Evening Textile School.

CALENDAR.

1929.

October 3, Thursday	Registration.
October 10, Thursday	Registration.
October 14, Monday	Opening of evening school.
November 28, Thursday November 29, Friday	Thanksgiving recess. No classes.
December 20, Friday	End of first term.

1930.

January 6, Monday	Opening of second term.
March 14, Friday	Closing of evening school.
April 8, Tuesday	Graduation.

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Florence Moore Lancey Librarian.	46 Victoria Street.
Helen Gray Flack, S.B. Secretary.	445 Stevens Street.
Mona Blanche Palmer Clerk.	685 Westford Street.
Ardean Kent Lance, S.B. Clerk.	137 Riverside Street.
Howard Dexter Smith, Ph.D. Evening Instructor in General Chemistry.	669 Westford Street.
Forrest Albert Mills Evening Instructor in Machine Shop.	North Billerica.
William Charles Ready, S.B. Evening Instructor in Mechanical Drawing.	10 Bertha Street.
Harold Arthur Giffin Evening Instructor in Design.	15 Burnaby Street.
Edith Clara Merchant Evening Instructor in Freehand Drawing.	268 Westford Street.
Harold Earl McGowan, B.T.E. Evening Instructor in Mechanical Drawing.	36 Varney Street.
Guy Eugene Branch Evening Instructor in Worsted Yarns.	Forge Village.
Arthur John Nakos Evening Instructor in Electricity.	101 Belrose Avenue.

EVENING CLASSES.

GENERAL INFORMATION.

Entrance Requirements.

All applicants to the evening classes must understand the English language and simple arithmetic. Those who are graduates of a grammar or high school are admitted upon certificate. Those who cannot present such a certificate are required to take examination in the subjects of English and arithmetic. In the examination in English a short composition must be written on a given theme, and a certain amount must be written from dictation. In the examination in arithmetic the applicant must show suitable proficiency in addition, subtraction, multiplication, division, common and decimal fractions, percentage, ratio and proportion. Opportunity to register or to take these examinations is offered each year, generally on the Thursday evenings of the two weeks previous to the opening of the evening school.

Registration.

Before entering the class a student must fill out an attendance card, which can be obtained at the office or from the instructors in the various departments.

Any student who has filed an attendance card and who wishes to change his course must notify the office before making the change.

Sessions.

The evening classes commence the second Monday of October and continue for twenty weeks. The school is open on four evenings each week during the period mentioned, except when the school is closed for holiday recesses.

Supplies.

Students must provide their own books, stationery, tools, etc., and pay for any breakage or damage that they cause.

Students' supplies will be sold from the co-operative store every evening school night from 6.45 to 8.15 P.M.

Fees and Deposits.

All evening courses are free to residents of Lowell. To those outside of Lowell the fee is $10 per year for *each course of two nights per week.* Students taking two courses or attending courses requiring more than two nights per week are required to pay $15 per year for three nights and $20 for four nights.

All fees and deposits must be paid in advance.

All students, whether from Lowell or not, taking Course 411, Chemistry and Dyeing Department, are required to make a deposit at the commencement of the course — $5 for first-year students, and $10 for second-year students. A deposit of $10 will be required of all students taking Course 412, 413 or 414. This is to cover the cost of laboratory breakages, chemicals, apparatus, etc., and at the end of the year any unexpended balance is returned, or an extra charge made for the excess breakage.

Every student who takes the chemistry and dyeing course must check up his desk with the instructor of that department when he leaves the school. Any student not doing so will be charged 50 cents.

All students taking Machine-Shop Practice will be required to make a deposit of $5. Any unexpended balance remaining at the end of the year will be returned to the student.

Report of Standing.

A report of standing covering the year's work is sent to all students who attend the entire year and take the necessary examinations.

Certificates.

The courses of the evening school are varied and arranged to meet the special needs of those engaged in the industry. They vary in length from one to four years, and at the completion of each course the certificate of the school is awarded, provided, however, that the student has been in attendance in the course during the year for which the certificate is granted.

GENERAL EVENING COURSES.

The object of these courses is to give young men of ambition an opportunity to obtain instruction in all the branches of science that are allied with their daily work. For example, one who is employed as a weaver in a textile mill may, by means of the course in manufacturing, obtain knowledge of the manufacture of yarn, the production of a design, and the methods of finishing a fabric, as well as the manner of its weaving or knitting. In like manner the dyer may augment his knowledge of the chemicals and materials he is daily handling. The engineer and machinist may acquire a knowledge of the mathematics, science of mechanics, electricity and drawing that underlie all the work of an engineer.

It is recognized that the interests of such students lie in a particular field of industry, and these courses are designed to bear directly upon the special line, and supplement, as far as possible, the practical work in which the student is engaged during the day.

In a word, any man having a common school education and the ambition to advance in his line may now secure a broad and comprehensive training in the subjects which will be of vital importance to him in obtaining the goal of his ideal.

A description of all courses follows.

COTTON DEPARTMENT.

110. Cotton Yarns — 3 Years.

The *first year* work in cotton yarn manufacture consists of a study of cotton and its preparation for market, followed by a study of opening, picking, carding and combing.

This work consists of lectures on these operations combined with problems that are peculiar to each operation such as the drafts used and the production of each process as well as the amounts of waste made. Special consideration is given to the adjustment and care of these machines and some laboratory demonstration is used to show the manner of adjusting machines for the purpose of controlling the weight of the product, the amount of work done in a day and the control of waste.

Cotton. — Before taking up the details of manufacturing cotton into yarn, a careful study of its physical characteristics is made. The geographical distribution of the areas producing commercial cottons is explained and the characteristics of the cottons produced in each are studied. A general explanation of the cultivation and harvesting of cotton is made, especially emphasizing the effect of agricultural factors on the cotton fiber and how these may serve to complicate manufacturing problems.

The ginning of cotton is considered, showing the yield of lint, the uses of cotton seed and the various types of gins and which cottons are commonly ginned on each.

The intricate system of buying and selling cotton is studied to illustrate the problems a mill may meet in procuring cotton. In this connection, special emphasis is placed on the classification of cottons by staple and by grade.

Opening and Picking. — Instruction in the preliminary operation of opening and picking covers the mechanical construction of the machines, their parts and adjustments, as fully as the manufacturing results accomplished by the machines. This includes such construction details as evener, lap measuring and safety stop motions, grids, cleaning trunks and beaters, also operation details which involve the adjustment for waste, drafts and character of laps. Some time is devoted to mixing in its various phases, showing in addition to improvement in uniformity of the product, how cottons are mixed to obtain definite average prices and how different percentages of color may be obtained by mixing, especially on the pickers.

Carding. — The process of carding is considered one of the most important, and proper time is devoted to the construction and operation of cards that the student may be familiar with the various parts of the card and the function and design of each. The construction and application of card clothing, as well as the methods of grinding, form a part of the work. Some time is given to a discussion of the waste made in carding, the regulation of the amounts of each made and the calculation of the percentages. New and special attachments for various purposes are brought to the attention of the class, illustrating possible ways of improving carding conditions.

COMBING. — The preparation of card sliver for combing, by means of the sliver lapper and ribbon lapper, is thoroughly considered. The combing operation itself is studied in considerable detail, emphasizing the general object and operations in combing and the specific means employed by various types of combs in performing the operation. The calculations in this connection involve the drafts and doublings necessary to produce the proper lap for the comb, the proper comb drafts, and the determination of the per cent of noil produced.

The *second year* work includes a study of the drawing and roving processes and the calculations that accompany these operations. It consists of lectures on the machines and demonstration of their adjustment, showing roll setting, draft and twist control, builder adjustment, spacing coils on the bobbin, and tension control.

DRAWING. — Under this head is taken up the theory of doublings and their effect upon the quality of roving and yarn. Like previous and subsequent processes the machine construction forms an important part of the work. Proper stress is paid to such subjects as stop motions, drawing rolls and their covering, clearers and evener motions.

ROVING PROCESSES. — Under this head are studied the various machines known as the slubber, intermediate, fine and jack fly frames. The relative motion of the various parts of these machines is so complex that a good opportunity is here presented to fix in the student's mind the application of certain mechanical principles that are used in other departments and upon other machines in the manufacture of textile material. With each process of yarn manufacture the systems of sizing and numbering are explained and under this head both the metric and English systems are considered.

During the *third year* the time is devoted to a study of ring and mule spinning, spooling, winding, twisting and reeling. As in previous years, the work consists of lectures and demonstration on the machines. During this year there is also some work done on the combing machine, particularly in the nature of its adjustment. In addition to these subjects, there is some work done in the way of planning the organization of a cotton mill with a view to showing drafts, speeds, productions and number of machines of each kind necessary for the production of a given amount of a certain yarn.

RING SPINNING. — The consideration of spinning yarn by the ring frame method involves a knowledge of the uses to which the yarn is to be put and subsequent methods of handling, that proper roving may be selected, suitable amounts of draft and twist provided, correct size of rings and travelers selected, and building motions suitably adjusted. Yarn defects are studied with reference to the cause and remedy, necessitating references to many of the earlier operations.

MULE SPINNING. — This method of spinning is very different from that of the ring frame, and the mechanical details are more complicated. The student is furnished with a new means of producing yarns, and can compare the relative advantages of each method. A thorough understanding of mule spinning is perhaps more a study of mechanical motions and their functions. This results almost invariably in assisting the student to understand previous processes and machines better because of his work on the mule. It is the object to make clear to the student's mind the principles underlying the construction and operation of the parts that control the drawing, twisting, backing off and winding, together with such special motions and devices as are used upon the modern mule.

SPOOLING AND WINDING. — The discussions under this head cover the treatment of single yarns, ring or mule spun, in preparation for twisting, comparing the relative merits of spooling with multiple winding on tubes, and beaming for special twisters. Winders are also considered as a means of preparing yarn packages for sale yarns.

TWISTING. — Because of the similarity to ring spinning, the emphasis is more on the manufacturing part of the work, although there are a few peculiar features of a mechanical nature. The twisting of various regular ply yarns, the making of numerous fancy yarns and the principles underlying the production of unlimited patterns is taken up here. The use of special twisters and other apparatus for cords and ropes is considered at this point.

112. Cotton Manufacturing — 4 Years.

The Cotton Manufacturing course is designed to give a student a broad knowledge of the manufacture of cotton cloth. To do this he is required to spend three years in the department of cotton yarns, studying cotton and its conversion into yarn. A student taking this course also spends two years in weaving, one on plain and one on dobby weaving. Three years are spent in a study of the art of designing a fabric and the analysis of fabric already constructed. One year is spent in a study of the processes involved in finishing cotton fabrics. For detailed description, see subjects under Yarns, Weaving, Designing and Finishing.

WOOLEN AND WORSTED DEPARTMENT.

210. Worsted Yarns — 2 Years.

During the *first year* instruction consists of a lecture course on the various kinds of wool fibers, trade terms, sorting, scouring, carbonizing, etc., also a course in carding and the calculations involved in the mechanism of the machines, and a course covering gilling and combing and the processes of top making. The *second year* is devoted to detail study of the English and French systems of worsted yarn manufacture.

211. Woolen Yarns — 2 Years.

During the *first year* instruction consists of a lecture course on the various kinds of wool fibers, trade terms, sorting, scouring, carbonizing, etc., also of a course on carding. The *second year* continues the instruction on carding and then takes up a course on the mule and woolen yarn spinning.

Raw Materials. — A study of raw materials which enter into the manufacture of woolen or worsted yarns, or are made into yarns by processes similar to those employed in the manufacture of woolen and worsted yarns, would include silk, mohair, alpaca, vicuna, cashmere, camel's hair and cotton. In connection with these are considered shoddy, noils and extracts.

Wool Sorting. — Familiarity with the various grades and kinds of wool is obtained by lecture. The various characteristics and properties are explained, as are also trade terms, such as picklock, XXX, XX, ½-blood, ⅜-blood, ¼-blood, delaine, braid, etc. Some skill is acquired in the estimation of shrinkage and in judging the spinning qualities.

Wool Scouring. — The object of scouring and the methods employed are explained, and this involves the consideration of the soaps and chemicals used in washing; also the waste products and their utilization. A demonstration of a commercial quantity of wool is scoured by machines that are made similar in operation to regular commercial machines. A study is made of the effect of the hardness of water upon soap. At the same time the use of driers, their operation and regulation, is taken up, and the methods of carbonizing wool, noils, burr waste, rags, etc., are studied and explained.

Burr Picking, Mixing, Oils and Emulsions. — The use of burr pickers in cleaning wool and the use of mixing pickers in making color blends is covered by lecture and demonstration. Under the subject of oils and emulsions are taken up the characteristics of various oils and the means employed to test them.

This work is taken only by those students who are pursuing the Woolen Manufacturing Course.

Carding. — The different systems of carding wool, depending on whether it is to be made into woolen or worsted yarns, are fully explained, as is also the construction, setting and operation of cards. A part of this work consists of a study of card clothing, its construction, application and grinding.

Woolen Mule. — The student studies thoroughly the operation of the mule as a whole, and acquaints himself with the various principal mechanisms, as, for example, the backing off and winding motions, the quadrant, builder-rail, faller regulation, etc.

Top Making and Combing. — This branch takes up, besides the carding of the wool on a worsted card, the preparing processes, backwashing, also gilling of the stock before and after combing. The construction of the gill boxes and combs is studied by lectures. Later, quantities of stock are made into top and then into yarn.

The Noble, Lister and French combs are studied, and the various calculations to determine draft, noiling, productions, etc., are made.

DRAWING AND SPINNING. — The equipment in the laboratory offers opportunity to make worsted yarn by either the Bradford or open drawing system or by the French system. The process includes the various machines in the successive steps of making Bradford spun yarn, and the functions of the different machines are studied. In the latter, or French system, the stock is run through the drawing machines, and the roving spun into yarn on the worsted mule. The same method of studying the mechanism and operations of these machines is followed as in the case of previous methods of instruction. The student by pursuing this course can compare the different methods of yarn manufacture and note the results of each.

With the instruction in spinning by the Bradford system is given work on the twisters and the effects that may be produced.

214. Woolen Manufacturing — 4 Years.

215. Worsted Manufacturing: Bradford System — 4 Years.

216. Worsted Manufacturing: French System — 4 Years.

These courses are arranged to give those engaged in the manufacture of woolens and worsteds instruction in the various branches of the work. It embraces a study of wools and allied fibers and the manner of manipulating from fibers to finished fabric, including all the processes of yarn manufacturing, weaving, designing and finishing. The instruction given in these three courses is the same throughout the four years with the exception of that given in yarns.

During the *first year* lectures are given on wool fibers and the preliminary processes of their conversion into yarns, calculations of the mechanism of the machines and elementary instruction in cloth designing and analysis.

During the *second year*, students selecting the Woolen Manufacturing Course follow a course in carding and mule spinning and continue the first year work in design and cloth analysis. Students taking either of the Worsted Manufacturing courses continue their work in yarns by studying gilling, combing and the processes of top making. More time is given this year to design and cloth analysis.

In the *third year* students continue their instruction in yarn manufacture, design and cloth analysis, and add the subject of weaving to the course.

During the *fourth year* instruction is given in weaving and finishing.

TEXTILE DESIGN AND WEAVING DEPARTMENT.

311. Cotton Design — 3 Years.

During the *first year* instruction is given in elementary designing, starting with all the foundation weaves which may be used in fabrics such as the plain weave, rib weaves, basket weaves, twill weaves, satin weaves, granite weaves, etc. Combbination and derivative weaves are made up from the aforesaid weaves. Fancy and figured weaves, in most cases originated by the student, are produced. Color effects, which are so essential in fabrics, obtainable from the different weaves, as stated above, in which the color arrangement of warp and filling create the pattern, are thoroughly considered. Not only the designing, but also harness drafting and the making of dobby chains for any type of weave is taken up.

Cloth analysis is considered in conjunction with designing, as a designer must know the kind of fabric he is designing, what material and what size of yarns are to be used, and how heavy and costly the cloth is to be. The various topics discussed are the sizes or counts of yarns made from all kinds of fibers, such as cotton, woolen, worsted, silk, rayon, jute and yarns of other vegetable fibers. Their relative length to the pound is determined in the single two or more ply, mixed yarns, novelty yarns and fancy yarns, in the American or English system. The same is given in the metric system. Problems involving the take-up of yarns in the weaving and finishing processes are given. Samples of cloth are picked apart to determine their weaves and general construction.

In the *second year* cloth analysis and design are combined in lecture and practice, starting with plain and leading into the more fancy cotton dobby fabrics. A great variety of samples of cloth are used in class work to determine ends and picks per inch, shrinkage in warp and filling, and the number of reed and reed widths

necessary for eventual reconstruction. The yarn numbers of warp and filling are determined by aid of fine balances. The amount of warp and filling necessary for a piece of goods is calculated and the weight of a whole piece as well as the number of yards per pound are determined.

In the *third year* more elaborate cloths are considered, both in designing and analysis, cloths in which extra warp or extra filling, or both, are used. Warp backed, filling backed, double, triple or more plied fabrics are taken up, such as marseilles, quiltings, piqué, suspenders, narrow webbings, velveteens, fancy velveteens, velvets, corduroys, Bedford cords, plushes, leno, in fact, anything a student may suggest which might help him in his work.

312. Woolen and Worsted Design — 3 Years.

This course covers the design and analysis of standard woolen and worsted fabrics and is intended for those who wish to specialize in this branch of textile fabric manufacture. Special and fancy fabrics are studied to the extent that time will permit.

During the *first year* instruction is given in the subject of classification of fabrics, use of point or design paper, plain fabrics, intersection, twills and their derivation, sateen, basket and rib weaves, checks and stripes, fancy weaves, including figured and colored effects; producing chain and draw from design, and *vice versa;* extending and extracting weaves.

The analysis of samples is taken up in a systematic manner, illustrating the various cloth constructions for the purpose of determining the design of the weave and the amount and kind of yarns used, and forms the basis of calculation in the cost of reproducing any style of goods. The various topics discussed are reeds and setts; relation and determination of counts of cotton, woolen, worsted, silk and yarns made from the great variety of vegetable fibers; grading of yarns, folded, ply, novelty and fancy yarns; application of the metric system to yarn calculation; problems involving take-up, average counts, determination of counts of yarn, and weight of yarn required to produce a given fabric.

During the *second year* instruction is given in cotton warp goods, blankets, bath robes, filling reversible, extra warp and filling backs, figured effects produced by extra warp and filling, double cloths and plaid backs.

The analysis work follows as closely as possible the type of fabrics taken up in the designing and the reconstruction of these fabrics with the consideration of their shrinkages and composition.

In the *third year* instruction is given in multiple fabrics, chinchilla, Bedford cords, crepon, matelasse and imitations, double plains, meltons, kersey, plush and suitings. At this time also is taken up the construction of designers' blankets, suggestion cards, and the construction of samples.

The construction of new fabrics from theoretical viewpoint together with the construction from suggestion cards is taken up. In connection with this work instruction is given in making cost estimates for both woolen and worsted fabrics.

314 Cotton Weaving — 1 Year.

The Course in Cotton Weaving covers instruction on plain looms, Draper Automatic and Stafford Automatic looms. It includes instruction on the construction of shedding and picking motions, take-up and let-off motions together with the operation of the magazines and hoppers and methods of changing shuttle and bobbin. A study is also made of the preparation of warps, beaming, sizing and drawing-in. The Crompton and Knowles Automatic Towel Looms and the various types of box looms, including chain building and work on multipliers, are also considered in this course.

315. Woolen and Worsted Weaving — 2 Years.

This course includes instruction on the Crompton and Knowles loom and takes up general construction, head motions, take-up, let-off, filling stop motion, etc. The preparation of warps, wet and dry dressing, is given in connection with this course.

316. Dobby and Jacquard Weaving — 1 Year.

This course considers the various types of Jacquard heads and dobbies, which includes single cross border dobbies and leno attachments on double lift dobbies,

handkerchief motions, leno weaving, center selvedge motions, filling changing looms, oscillating reeds, lappet motions, various shaker motions, towel and other pile cloth weaving. The course on Jacquard looms includes general construction, card cutting, lacing, repeating, and fixing.

317. Freehand Drawing — 3 Years.

In the course of freehand drawing, instruction is given in the drawing from models, casts and designs. Work is taken up in charcoal and also in colors. This course has appealed to many young women of the city, and it is believed that this is a most fortunate opportunity for both young women and young men of Lowell to acquire the elements of artistic designing.

CHEMISTRY AND DYEING DEPARTMENT.

Hardly any branch of applied science plays so important a part in our industrial world as chemistry. Many large mills employ the chemist as well as the dyer, and with the great progress which is being made in the manufacture and application of dyestuffs, a basic knowledge of chemistry becomes an absolute necessity to the dyer. Within a comparatively short distance from Lowell are establishments employing men who require some knowledge of chemistry but who may not necessarily use dyes. Some find a knowledge of analytical chemistry helpful in their everyday work.

To meet these varying needs of our industrial community, the school offers a two-year course in general chemistry, organic and inorganic, which may be followed by any one of three courses, viz., textile chemistry and dyeing, analytical chemistry, and textile and analytical chemistry. In order to take Courses 412, 413 or 414, candidates must have a certificate from Course 411, or show by examination or approved credentials that they have taken the equivalent of the work covered by this course.

411. Elementary Chemistry — 2 Years.

General Chemistry, including Inorganic and Organic.

Qualitative Analysis.

One lecture and one Laboratory Period per week in General Chemistry the first year, continued three nights a week during the second year, when the Elementary Organic Chemistry and Qualitative Analysis is completed.

Instruction in Elementary Chemistry extends through two years, and includes lectures, recitations and a large amount of individual laboratory work upon the following subjects:—

Theoretical Chemistry. — Chemical action, chemical combination, combining weights, atomic weights, chemical equations, acids, bases, salts, Avogadro's law, molecular weights, formulæ, valence, periodic law, etc.

Non-metallic Elements. — Study of their occurrence, properties, preparation, chemical compounds, etc.

Metallic Elements. — Study of their occurrence, properties, metallurgy, chemical compounds, etc.

The students take up, as thoroughly as time will permit, the qualitative detection of the more common metals and non-metals, with practical work.

This work, although necessarily elementary, is intended to prepare the student to study more understandingly the manufacture of dyestuffs and coal tar colors in the more advanced courses which follow.

During the first year of the Elementary Chemistry course most of the time is devoted to the non-metals and theoretical chemistry, and the laboratory work covers briefly the non-metals.

During the second year the classroom work is upon metals and the hydrocarbons and their derivatives, and the laboratory work consists entirely of Qualitative Analysis. While this course is necessarily taken up in an abbreviated and elementary manner, it is so arranged that the students may become familiar with the separations and the detections of the common metals and acids. This course is also preliminary to the work given in Analytical Chemistry.

412. Textile Chemistry and Dyeing — 3 Years.

Lectures in Textile Chemistry and Dyeing.

Laboratory Work in Dyeing.

Covered by 40 lectures and two nights of laboratory work per week.

The outline of the lecture course given in Textile Chemistry and Dyeing is as follows: —

Technology of Vegetable Fibers. — Cotton, linen, jute, hemp, china grass. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Animal Fibers. — Wool, mohair, silk. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Artificial Fibers. — Study of the various forms of artificial silk, the process of manufcature, their properties and action with chemicals, acids and heat.

Operations preliminary to Dyeing. — Bleaching of cotton and linen; wool-scouring; bleaching, fulling and felting of wool; carbonizing; silk-scouring and bleaching; action of soap.

The bleaching of cotton is studied with description of the various forms of kiers and machinery used; also the action of the chemicals used upon the material, and the various precautions that must be taken in order to insure successful work.

Under this heading is included a study of the reagents used in the emulsive wool-scouring process, and their action upon the fiber under various conditions; also the most successful of the solvent methods for degreasing wool.

Water and its Application in the Textile Industry. — Impurities present, methods for detection, their effect during the different operations of bleaching, scouring, dyeing and printing, and the methods used for their removal or correction.

The important subject of boiler waters is also studied under this heading, with a full discussion of the formation of boiler scale, its disastrous results, and the methods by which it may be prevented.

Mordants and Other Chemical Compounds used in Textile Coloring, and classified as Dyestuffs. — Theory of mordants, their chemical properties and application, aluminum mordants, iron mordants, tin mordants, chromium mordants, organic mordants, tannin materials, soluble oil, fixing agents, leveling agents, assistants, and numerous other compounds not dyestuffs that are extensively used in the textile industry.

Under this heading are included the definitions of various terms and classes of compounds used by textile colorists, such as color lakes, pigments, fixing agents, developing agents, mordanting principles and leveling agents.

Natural Organic Coloring Matters. — Properties and application of indigo, logwood, catechu or cutch, Brazil wood, cochineal, fustic, turmeric, madder, quercitron bark, Persian berries, and other natural dyestuffs that have been used in recent years by textile colorists.

Mineral Coloring Matters. — Under this heading are discussed the properties of such inorganic coloring matters and pigments as chrome yellow, orange and green, Prussian blue, manganese brown, iron buff.

Artificial Coloring Matters. — General discussion of their history, nature, source, methods of manufacture, methods of classification and their application to all fibers.

Besides lectures and recitations upon the subject of Textile Chemistry and Dyeing, practical laboratory work is required. By the performance of careful and systematic experiments the student learns the nature of the various dyestuffs and mordants, their coloring properties, their action under various circumstances, and the conditions under which they give the best results. The more representative dyestuffs of each class are applied to cotton, wool and silk, and each student is obliged to enter, in an especially arranged sample book, a specimen of each of his dye trials with full particulars as to the conditions of experiment, percentage of compounds used, time, temperature of dye baths, etc.

For convenience and economy most of the dye trials are made upon small skeins or swatches of the required materials, but from time to time students are required to dye larger quantities in the full-sized dyeing machines.

413. Analytical Chemistry — 3 Years.

Laboratory Work and Lectures in Quantitative Analysis.

Three nights per week of class-room and laboratory work.

The object of this course is to give the student a general idea of the underlying principles of Analytical Chemistry, with a sufficient amont of laboratory work to enable him to become proficient in performing the ordinary routine analysis of the textile plant. Frequent recitations are held for the discussion of methods and the solution of stoichiometrical problems.

The work covered the first two years is based on Smith's "Quantitative Analysis," and for the advanced work, consisting of the analysis of soap, water, oils, cloth and other materials of particular interest to the textile chemist, special lecture notes and Griffin's "Technical Methods of Analysis" is used as a text.

414. Textile and Analytical Chemistry — 4 Years.

Lectures in Textile Chemistry and Dyeing.

Laboratory Work in Analytical Chemistry.

Combines all lectures in Textile Chemistry and Dyeing with work of Course 413, but does not include any Dyeing Laboratory. Three nights per week.

TEXTILE ENGINEERING DEPARTMENT.

This department has arranged to offer those courses of study which lie at the foundation of all engineering. These are designed to give to those engaged in the mechanical, electrical, and manufacturing departments of mills, factories and other industrial establishments an opportunity to learn something concerning the theory underlying the many practical methods which they use in their daily work. Those subjects for which there is usually a regular demand are listed and described below, but similar and allied courses will also be arranged for provided there is a sufficient demand. In the case of all courses there must be an enrollment of at least ten properly qualified students to warrant giving the subject.

613. Mechanical Drawing — 3 Years.

For one having occasion to make a sketch or detail drawing for the purposes of illustration or instruction, or for one who is daily required to work from a drawing or blue print, the course in Mechanical Drawing is offered. It first lays a foundation of the principles of mechanical drawing, and follows this with two years' work in drawing directly from parts of machines, preparing both the detail and the assembly drawing.

This course is a complete course in drawing and requires two evenings per week for three years for its completion. The work is so planned that at its completion a man shall be thoroughly familiar with the making of a working or shop drawing. After a study of the underlying principles of projections and instruction in penciling, inking, lettering and tracing, the subject of sketching and the making of detail drawings therefrom is especially stressed. The preparation of assembly drawings is finally considered.

614. Machine Shop Practice — 2 Years.

This course offers an opportunity to learn the art of metal working and is equally valuable to the man who already has some knowledge of the methods employed as to one who has no knowledge of the same. Thus it becomes possible for one who may be working at the bench during the day to learn how to operate a lathe or other machine tool, or for a lathe hand to acquire a knowledge of a planer, shaper, milling machine, or grinder. A series of lectures is given on the care and management of tools, tool grinding, and the mechanism of the machines. A man who only has a knowledge of the special machine which he operates may by means of this course become a more intelligent machinist. He should supplement this study with the courses in Mechanical Drawing, and in Mechanics and Mechanism, in order that his training for an all-round machinist or mechanic may be more complete. The time required is two evenings per week.

619. Mechanics and Mechanism — 2 Years.

This is one of the most important of engineering subjects dealing as it does with the principles which underlie the transmission of force and motion through

machines and mechanical devices. Its principles are so fundamental and so widely used in more advanced subjects that the student should not consider himself qualified for further work until he has mastered the principles of this subject.

Beginning with a discussion of such important topics as work, power, horsepower, energy and the like, the student then studies the fundamental mechanical principles which are exemplified by the lever, jackscrew, pulley block, inclined plane, wedge, differential pulley and other similar devices. This is followed by consideration of the simpler relations pertaining to uniform and accelerated motion and the course concludes with a study of pulleys, belting, gears and gearing, as far as time permits. No student should undertake this course who is not thoroughly familiar with elementary mathematics. This subject requires attendance two evenings per week with home problem work and the study of a text book.

620. Mathematics — 2 Years.

This course is designed to permit the student to pursue further by evening study the mathematics of his grammar or junior high school course. It includes algebra, elementary trigonometry, logarithms and slide rule, and requires attendance for two evenings per week. It should be taken by all who intend to study further into engineering subjects. Instruction is largely through problem work in class and at home, and the use of a text book.

Some of the topics treated are —

Elementary algebraic operations of —
- Addition.
- Subtraction.
- Multiplication.
- Division.
- Factoring.
- Fractions.
- Graphical representation.

- Linear equations.
- Radicals.
- Quadratic equations.
- Logarithms.
- Slide rule.
- Trigonometry.

621. Strength of Materials — 1 Year.

This interesting subject deals with those important principles whereby the person engaged in machine, engine, mill or building design may ascertain whether the parts are strong enough to carry the forces and loads which the nature of the construction imposes upon them.

The fundamental stresses of tension, compression and shear are first considered, together with the ultimate strength of cast iron, wrought iron, steel, and timber. The practical use of this information is illustrated in the design of bolts, tie rods, columns, wall piers, boiler shells, riveted joints, etc. This is followed by a study of the stresses in and design of beams under various conditions of loading, and the course concludes with a discussion of the torsional stresses and twist in shafts. A knowledge of the principles of Mechanics and Mechanism is highly desirable to a satisfactory understanding of this subject. The time required is one evening per week and the method of instruction is through lectures, recitations, problems, and the use of a text book.

622. Steam — 1 Year.

It is the purpose of this course to study the various methods of heat generation, transmission, and utilization in use at the present day and to learn the theoretical relationships which underlie these processes and transformations.

The instruction covers, so far as time permits, the elements of steam engineering. The topics covered are heat and its measurement, use of steam tables, types of boilers, engines and turbines, boiler and engine room accessories, together with a study of the methods of testing the various types of apparatus. Actual tests on such equipment are made as the size of the class permits. Text book, laboratory and class work, and home problems are the methods of instruction used, requiring an attendance of one evening per week.

623. Direct Current Electricity — 2 Years.

This popular course is planned to cover the fundamentals of direct current circuits and machinery. The lectures on electrical theory are supplemented by laboratory work and the use of a text book and problems. It requires for its completion attendance for two evenings per week and a considerable amount of home study and preparation. Students who wish to take this subject must have studied one year of algebra.

The fundamental properties of electrical and magnetic circuits are studied both in the classroom and laboratory. Other topics include the measurement of resistance, the calculation and measurement of power in direct-current circuits, and the relation between the electrical, heat and mechanical units of energy. A large amount of laboratory and class work is given to make the student familiar with methods of operation, testing and control of direct current machinery.

624. Alternating Current Electricity — 2 Years.

This course is similar to Course 623 except that it deals with alternating current circuits and machinery. No student should plan to take this course unless he has previously taken at least one year of Course 623 or can show that he has had the equivalent.

The fundamental properties of alternating current circuits are first considered, and are followed by a study of the operation of alternating current machinery. The study of electrical measuring instruments is also included in this course. The instruction is given by means of lectures, recitations, and a large amount of laboratory work. An attendance of two evenings per week is required.

FINISHING DEPARTMENT.

In these courses machine work is supplemented by lectures and discussions pertaining to the many finishes given to fabrics. The action of soaps, water, steam, heat and cold upon cloth containing one fiber or combinations of fibers as used in commercial fabrics is carefully studied. These courses also help the finisher to broaden his knowledge of textile fabrics. Attendance is required for two evenings per week.

710. Woolen and Worsted Finishing — 1 Year.

The outline of this course, which is given chiefly by means of lecture work, is as follows: —

Burling and Mending. — Under this head are taken up for consideration the examination of flannel as it comes from the loom; the construction, use and location of the perch; the methods used in marking defects, measuring, weighing and numbering of cloths; also the methods of inspection for fancies, single cloths and double cloths. The object of burling, mending and the types of tables employed, the method of removing knots, runners, etc., the object of back shearing and the use of burling irons, the replacing of missing threads and the importance of sewing as a part of the finishing process, are all considered in detail. The removal of oil and tar spots as well as stains of various kinds is studied.

Fulling. — This branch covers a study of the conditions of the flannel as it comes from the loom, and the influence of oil, etc., upon the procedure. Considerable time is devoted to the various methods of producing a felt, the various types of stocks and their modifications and development into the present type of rotary fulling mills of both single and double variety. The details of construction in all machines are carefully taken up and include the design and composition of the main rolls, methods of covering, regulation and means of adjusting the pressure of traps and rolls, and the use and regulation of the various types of stop motion, the different types of stretchers, guide rolls and throat plates.

The theory of felt is taken up and the influence of pressure, moisture, heat, alkali and acid is considered, as well as the hydroscopic and felting properties of different wool fibers. The preparation of the flannel for the mill and the usual methods of determining shrinkages, as well as the various methods of soaping, are given careful attention. The preparation of various fulling soaps and the value of each for the production of various degrees of felt, as well as the determination of the proper amount of alkali for various goods, are carefully studied and demonstrated. The manipulation of the various kinds of goods in the mill, viz., all wool, reworked wools and mixed goods, is studied in classroom and by operation in the laboratory.

The change in weight and strength for each operation is carefully considered, as is also the value of the flocks made in each. A study of the various methods of flocking, such as dry and wet, is considered in both class and machine rooms. In each operation the defects likely to materialize are studied, as well as the cause thereof, and various methods of modifying or lessening them.

Washing and Speck Dyeing. — This branch considers the scouring, rinsing and washing of goods both before and after the fulling process; the various types of washers; and the details of construction, such as suds box, rolls, etc. The theory of scouring, uses of Fullers' earth, salt solutions and sours on the different kinds of goods are made clear by practical work in the machine room, where the effects due to improper scouring, such as stains, cloudy effects, wrinkles and unclean goods, are demonstrated. The discussion of the necessity of speck dyeing follows naturally from the study of these matters, and includes methods of preparation, materials used, application and tests required.

Carbonizing. — This is an important branch of finishing, and includes a study of the various carbonizing agents, methods of application, strength of solutions and neutralizing, as well as the machines used. Stains and imperfections resulting from carbonizing are also considered. The drying and tentering machines and extractors employed are taken up at this point.

Gigging, Napping and Steaming. — The construction in detail of the various types of gigs, nappers, steamers, wet gigs, rolling, stretching, crabbing and singeing machines is discussed, and their actions upon the cloth and the results obtained are explained.

Various methods of obtaining luster and the production of permanent finish are considered in connection with steaming and sponging.

Brushing, Shearing and Pressing. — This includes, as do the other branches, a careful treatment of the machine employed, the preparation of the cloth for each process, the action of each machine in producing its part of the resultant effect. In manipulation of the shear consideration is given to its setting, grinding and adjustment. With the brushing machine the effect of steaming and moisture upon the luster and feel of the goods is shown. A study of the action of the presses, both plate and rotary, involves consideration of pressure, steaming, etc. Special processes to obtain particular effects are taken up, and the part played by each machine is explained. The details involved in handling cloth on a commercial scale, as, for example, measuring, weighing, ticketing, numbering and rolling, are also explained. The necessary calculation and the methods of finishing all grades of goods are considered from time to time during the year.

711. Cotton Finishing — 1 Year.

The outline of the course in the finishing of cotton fabrics is as follows: —

Cloth Room. — Instruction of the various goods and the object thereof; construction of the various types of inspecting and trimming machines.

Shearing. — The object. A consideration of the various types of shears for treating one or both sides at the same time; also the use of the usual cleaning devices, such as emery, sand and card rolls, beaters and brushes; grinding and the adjustment of the various parts.

The use of brushing and cleaning machines, rolling devices and calendar attachments for gray goods.

Singeing. — Developing and object of singeing; the construction of singers of all types, and for various purposes; the use of cooling tanks, steaming devices, rolling and brushing attachments.

Regulation of the flame for various goods, and adjustment of the parts; gas and air pressure, water-cooled rolls; the effect of moisture on the cost of singeing; the use of dry cans in connection with singeing; electric singeing.

Washing. — Open width and string washers, their construction and operation; soaps, temperature, squeeze rolls; washing of various goods and the object thereof; stains.

Napping. — The object of napping and the usual method of treating goods; various types of nappers, single and double acting; felting nappers; construction, grinding and adjustment of various types.

Water Mangles. — Their object and the construction of various types; various rolls, — iron, husk, etc.; scutchers, their object and construction.

Starch Mangles. — The object and construction of all types of starch mangles for pure starch and filled goods; various types of rolls, — brass, rubber, wood; action of doctor blades, etc.; regulation and object of pressure.

Methods of starching and finishing all standard goods, also a consideration of the various substances used, such as starch, softener and fillers; the preparation of starch and various methods of application.

Dryers and Stretchers. — Both horizontal and vertical, tenter frames, clips; the swing motion and the finishes thus produced; construction; spraying machines, belt stretchers, button breakers; their object and construction.

Calenders. — The object and construction of all types, including the regulation of pressure and nips for the production of various finishes; various types of rolls and their uses, — steel, husk and paper; the use of hot and cold rolls; chasing, friction, embossing and Shriner calenders and the various finishes produced by each; production of watered effects; beetling machines.

Making up room, — yarding, inspecting; different types of folds; pressing, papering, marking.

EVENING GRADUATES OF 1929.

Certificates awarded as follows, April 2, 1929:

Cotton Yarns — 3 Years

Joseph Daniel Casey . . . . Lawrence, Mass.
James Francis Tattan . . . . Lawrence, Mass.

Woolen Manufacturing — 4 Years

William Augustine Blute . . . . . . Lawrence, Mass.

Worsted Yarns — 2 Years

Laurie Stanford Baker . . . . . . Methuen, Mass.
Charles Julien Lô Florin . . . . . . Lawrence, Mass.
Alfred George Miller . . . . Lawrence, Mass.
Claude Alfred Taylor . . . . . . Lawrence, Mass.
Gilbert Freeman Tallmadge . . . . . Lawrence, Mass.

Cotton Design — 3 Years.

John Leslie Merrill . . . . Lowell, Mass.
Norman Everett Primrose . . . . . . Nashua, N. H.
Horatio Herbert Woodhead . . . . . . Andover, Mass.

Woolen and Worsted Design — 3 Years.

John Alfred Ebhardt . . . . Lawrence, Mass.
George Pickering Edney . . . . . . Lowell, Mass.
John Bain Gledhill . . . . Lawrence, Mass.
Ovila Eugene Langlois . . . . . . Lowell, Mass.
Guy Davis Reynolds . . . . Cambridge, Mass.
Benjamin Harrington Shaw, Jr. . . . . . Waltham, Mass.

Cotton Weaving — 1 Year.

Henry Stark Anderson . . . . . . Roxbury, Mass.
George Ralph Collins . . . . . . Lowell, Mass.
Manuel Cunha Espinola . . . . . . Lowell, Mass.

Dobby and Jacquard Weaving — 1 Year.

Theobald Eneas Trudeau . . . . . . Nashua, N. H.

Woolen and Worsted Weaving — 2 Years.

Stephen Augustine Hayes . . . . . . Lawrence, Mass.

Freehand Drawing — 3 Years.

John Arthur Cunningham . . . . . . Lowell, Mass.
Ann Gertrude Murphy . . . . . . No. Chelmsford, Mass.
Mary Ida Noonan . . . . Lowell, Mass.
Lela Grace Palmer . . . . Lowell, Mass.

Cotton Finishing — 1 Year.

Thomas William Critchley . . . . . Dracut Centre, Mass.

Frank John Kannheiser	Lawrence, Mass.
George Joseph Knox	Lawrence, Mass.
Abraham Sidney Levenson	Dorchester, Mass.
Robert Edson Tacy	No. Andover, Mass.

Woolen and Worsted Finishing — 1 Year.

Oswald Theodore Beck	Lawrence, Mass.
George Coates	Methuen, Mass.
George Byron Coleman, Jr.	Lawrence, Mass.
John Alfred Ebhardt	Lawrence, Mass.
George Edward Hertrich	Lawrence, Mass.
Ovila Eugene Langlois	Lowell, Mass.
Harold Joseph Lynch	Lawrence, Mass.
Max Werner Winkler	Lawrence, Mass.

Elementary Chemistry — 2 Years.

Edward Wilcox Clement	Nashua, N. H.
Charles Edward Foley	Nashua, N. H.
Harry Goshgarian	Lowell, Mass.
Herbert Charles Haller	Lawrence, Mass.
Norman Dane Hamel	Haverhill, Mass.
George Edward Kiley	Methuen, Mass.
Arthur William Lemkin	Lowell, Mass.
James Lester Lipsett	Methuen, Mass.
Harold Norman Logan	Lowell, Mass.
William Paul McCarthy	Lowell, Mass.
Robert Terrence McGuire	Methuen, Mass.
George DeCourcy Moran	No. Andover, Mass.
Ralph Patten	Lawrence, Mass.
Willard Brooks Phelps	Nashua, N. H.
Ralph Quance	Methuen, Mass.
Joseph Chanel Ricard	Lawrence, Mass.
Chester Edward Ruston	No. Billerica, Mass.
Sumner Edmunde Shepard	Methuen, Mass.
Redvers Smith	Methuen, Mass.

Textile Chemistry and Dyeing — 3 Years.

Henry Francis Kane	Lawrence, Mass.
Wilfred Irving Racicot	Lowell, Mass.
Hugh Alexander Ross	Lowell, Mass.
William Elliott Small	Somerville, Mass.

Steam — 1 Year.

Jesse Gordon Colman	Lawrence, Mass.
George Alexandre Eno	Lowell, Mass.
Timothy Aloysius Kennedy	Lowell, Mass.
Joseph Herman Parent	Lowell, Mass.
William Walker	Lowell, Mass.

Strength of Materials — 1 Year.

Frederick Lovejoy Fisher	Methuen, Mass.
Raymond Gates Flanders	Nashua, N. H.
Timothy Aloysius Kennedy	Lowell, Mass.
Howard Lester MacDonald	Lowell, Mass.
George Edward Pickel	Lowell, Mass.
John Delbert Stewart	Lowell, Mass.
Manuel Mello Veiga	Lowell, Mass.

Direct Current Electricity — 2 Years.

Frederick Lovejoy Fisher	Methuen, Mass.
Lemuel Raymond Gallagher	Nashua, N. H.
Lester John Gibson	Lowell, Mass.
Kendall William Gordon	Lowell, Mass.
Wycliffe Maidment	Lowell, Mass.
Everett Claude Sudsbury	Nashua, N. H.

Alternating Current Electricity — 2 Years.

Paul Westcott Buxton	Hudson, N. H.
Clarence Wadsworth Hope	Lowell, Mass.
Frank Vera Perry	Nashua, N. H.

Mechanical Drawing — 3 Years.

Raymond Gates Flanders	Nashua, N. H.
Florand Joseph Gauthier	Lowell, Mass.
Bessie Jane Peabody	Lowell, Mass.

Machine Shop Practice — 2 Years.

William Ludger Allard	Lowell, Mass.
Jerry Bibeault	Lowell, Mass.
Edward Blaha	Lowell, Mass.
George Archible Matthews	Lowell, Mass.
William Blair Mochrie	Lowell, Mass.
Frank Nuttall	Lowell, Mass.
John Francis Ryan	Lowell, Mass.

Mathematics — 2 Years.

Norman Barraclough	Methuen, Mass.
Joseph Birks, Jr.	Methuen, Mass.
John Ellis Boocock	Lowell, Mass.
John Austin Carey	Lowell, Mass.
Charles Lincoln Daley	Lowell, Mass.
Edward Stanley Edwards	Lowell, Mass.
Howard Wilmott Edwards	Lowell, Mass.
James William Gagnon	Lowell, Mass.
Raymond Eliot Gleason	Lowell, Mass.
Louis Theodore Grondin	Lowell, Mass.
Edward George Haines	Lowell, Mass.
Stephen Augustine Hayes	Lawrence, Mass.
Rogers Charles Holmes	Lowell, Mass.
John Janas	Lowell, Mass.
Robert Miller Kennedy	Lowell, Mass.
Louis Kochanek	Lowell, Mass.
Walter Bertram McCallum	Lowell, Mass.
Weston Pearl Major	Lowell, Mass.
Joseph Ignatius Manning	Lowell, Mass.
Calvin Edgar Buxton Metcalf	Lawrence, Mass.
Charles David Perham	Lowell, Mass.
George Edward Pickel	Lowell, Mass.
James Quance	Methuen, Mass.
Albert Daniel Randall	Lowell, Mass.
George Kenneth Ratcliffe	Lowell, Mass.
Leon Rupert Robarge	Lowell, Mass.
Lawrence Rae Spaulding	Nashua, N. H.
James Venn	Forge Village, Mass.

SERIES 33, No. 2 *November, 1929*

BULLETIN

OF THE

Lowell Textile Institute

LOWELL, MASS.

Issued Quarterly

1929 - 1930

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under Act of Congress of July 16, 1894
Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized October 21, 1918

Moody Street and Colonial Avenue

Publication of this Document approved by the Commission on Administration and Finance

2500. 11-'29. Order 7297.

Long Draft vs. Normal Draft

BY GILBERT R. MERRILL, B. T. E., *Professor of Textiles*
In Charge of
DEPARTMENT OF COTTON YARNS AND KNITTING
LOWELL TEXTILE INSTITUTE

The studies which served as a basis for the results shown in this bulletin were carried on during the last two years in the laboratories of the Lowell Textile Institute by A. B. Storey and J. C. Westaway in 1927-28 and C. L. Shelton and B. J. Zalkind in 1928-29.

Two of the more prominent long draft systems and one ordinary draft system were used. One short frame was equipped with ordinary drawing rolls on one side and long draft rolls on the other side. A second frame was equipped with the other long draft system. These two frames, both tape driven, were set up to have the same spindle speed, 9000 r. p. m. Rings of 1⅝ inches diameter were used at every spindle. The same travellers were used on both frames for the spinning of any one count.

The frames were adjusted to give as near the same counts as possible. All three lots of yarn were spun during the same hours and under the same conditions.

The staples used were from 1 inch to $1\frac{3}{16}$ inches. The counts spun ranged from 18's to 40's, some from single roving and some from double roving. With one exception, the yarns of any one count were spun from rovings of the same staple. The only count spun from two staples was 27's with a low draft. Inasmuch as another lot of 27's was spun using the same staple for each system, this merely gave an extra test for this count.

The following table gives some details regarding the original layout for spinning the various counts. In each case, the draft used on the ordinary system is given first and that for the two long draft systems second.

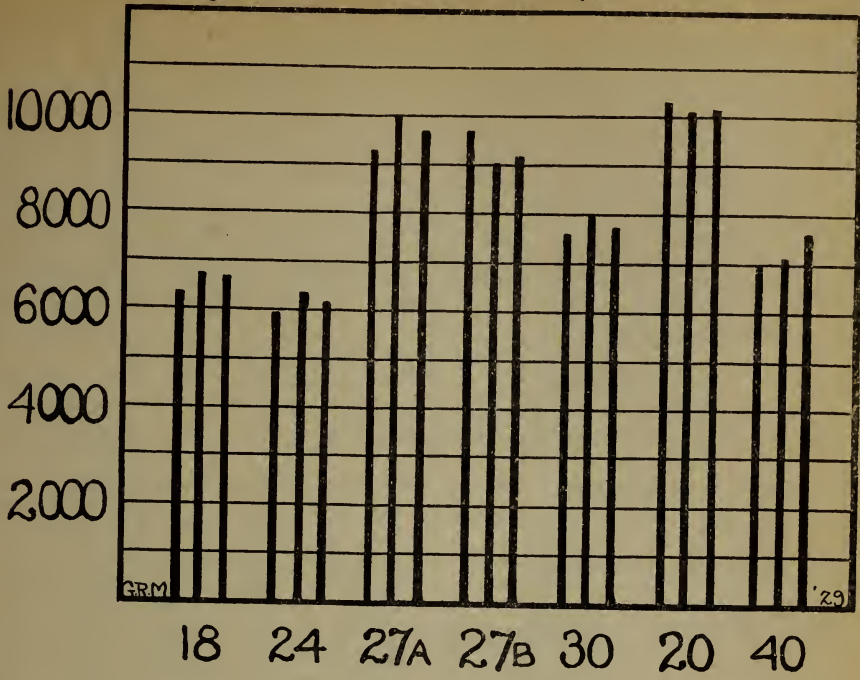
SPINNING DRAFT LAYOUT.

Counts	Staple	Roving		Draft
18	1″	4.30	2	8.375
		3.00	2	12.00
24	1″	4.30	2	11.15
		3.00	2	16.00
27A	$1\frac{3}{16}$″	3.67	1	7.1
		1.27	1	21.2
27B	$1\frac{3}{16}$″	3.67	1	7.1
	$1\frac{1}{8}$″	1.96	1	13.8
30	$1\frac{3}{16}$″	3.67	1	8.2
		1.27	1	23.6
20	$1\frac{1}{4}$″	2.60	1	7.7
		2.60	2	15.38
40	$1\frac{3}{16}$″	5.00	1	8.00
		3.67	2	22.00

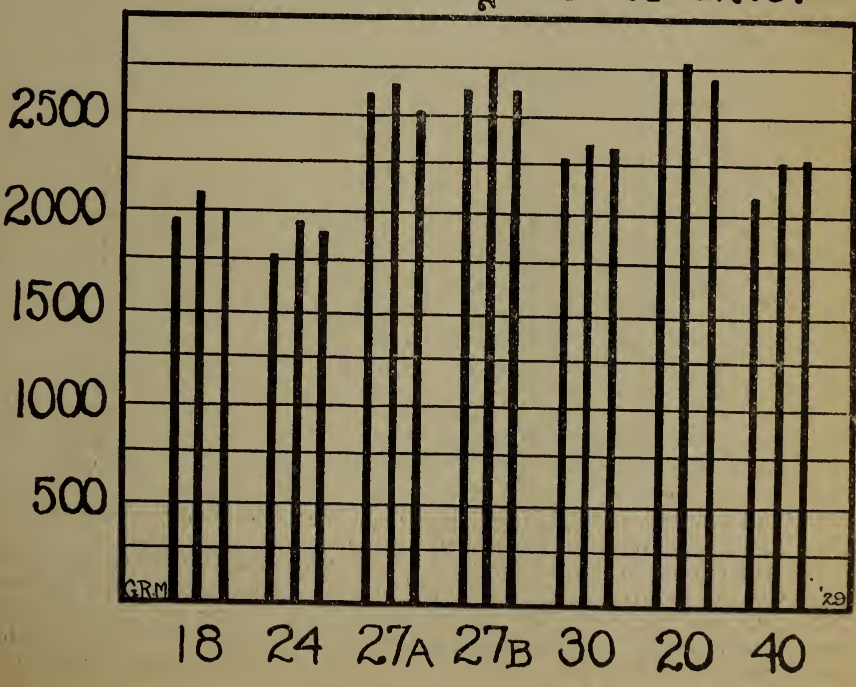
The two lots 18's and 24's were spun from the same carded rovings to give a low and a high draft for the one inch staple.

The same thing held true for 27 A's and 30's, except that the change in draft was not as great and the rovings were of combed stock. The last two counts 20's and 40's, were spun with combed double roving for the long draft systems and combed single roving for the regular system. For the 20's, the long draft was double the ordinary draft, while for 40's it was nearly three times the ordinary draft.

Single Strand Strength Constants.



Skein Strength Constants.



The three lots of each count were marked and kept separate and finally all the yarns were stored in the testing laboratory in a relative humidity of 65% at 70 degrees Fahrenheit. The strength of 120 yard skeins and of single strands was found at this condition, the counts were determined and the strength was multiplied by the actual average counts to give the strength constant which was used in comparing the various yarns.

This strength constant was used because it represents both the counts and the strength. If the counts vary, it must be expected that as the counts are finer the strength will be less. It is possible to say that within a small range of difference in counts, the strength multiplied by the counts should be constant if the yarns are equivalent to each other in strength. The Draper Standards will show but very slight differences for strength within a small variation of counts.

The two theses giving the results of these studies required about ninety typewritten pages, most of which was tabulated results of the various tests made on these counts of yarns. The figures in this summary are condensed results from these tests.

SKEIN TEST SUMMARY

STRENGTH CONSTANTS — 120 YARD SKEINS

Counts	Ordinary	A	B
18	1897	2107	1996
24	1785	1967	1910
27A	2625	2660	2530
27B	2650	2745	2640
30	2308	2352	2341
20	2750	2785	2710
40	2108	2257	2282

SINGLE STRAND TEST SUMMARY

STRENGTH CONSTANTS

Counts	Ordinary	A	B
18	6276	6639	6579
24	5888	6320	6055
27A	9266	9972	9614
27B	9657	9045	9230
30	7538	7890	7662
20	10282	10074	10210
40	6983	7132	7567

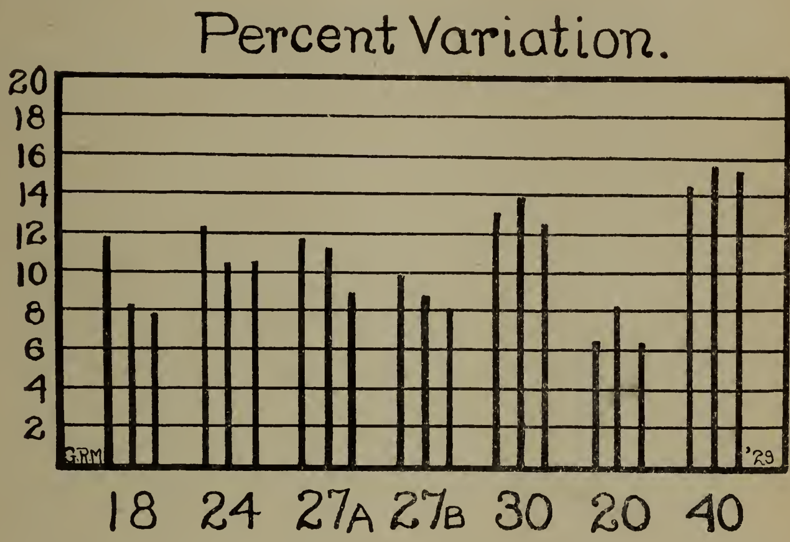
The figures of the preceding tables were plotted on two accompanying charts. The groups of three vertical lines represented the values of the strength constants for each count. In every case, the line on the left was for the ordinary system, that in the center was for the long draft system A, and the line on the right was for the long draft system B.

The uniformity of these yarns was tested on a special piece of apparatus which measured the thickness of the yarn with a delicate feeler and by means of a small mirror gave the readings for the variations in the yarn. The records gave the variation of the yarns in per cent based on the average thickness. The following table gives a summary of the figures for the various yarns.

UNIFORMITY TEST SUMMARY

Counts	Ordinary	A	B
18	11.83	8.28	7.72
24	12.49	10.51	10.52
27A	11.61	11.31	9.00
27B	9.89	8.73	8.24
30	12.95	13.93	12.52
20	6.39	8.34	6.44
40	14.52	15.48	15.16

The figures of this table were plotted on the chart "Percent Variation". The figures were grouped as in the strength charts, with the ordinary system at the left, long draft system A in the center and long draft system B at the right.



When all these yarns were considered, it seemed logical to conclude that the A long draft system produced yarns which averaged slightly stronger than those of the B system. The charts showed four places where this was not true but in the other ten cases it was true. This difference was relatively slight and under commercial conditions might not be maintained.

Both long draft systems showed strengths consistently better than the ordinary system, which was the real point of comparison in these studies.

The carded yarns from the long draft systems showed decidedly better uniformity than from the ordinary system, which did not seem to be maintained with the combed yarns.

In three out of five cases, the A system showed less uniform combed yarns than those from the ordinary system. It must be kept in mind, however, that the 20's and 40's were from single roving on the long draft systems, which may explain this deficiency.

The combed yarns produced on the B long draft system showed better uniformity than the ordinary yarns except for the 20's and 40's, and the 20's was practically equal to the ordinary 20's.

Taking the figures as a whole, the B long draft system produced a more uniform yarn than either of the others and the A long draft system produced yarns on the average slightly more uniform than the ordinary yarns. This,

however, was because the carded yarns were considerably more uniform while the combed yarns were slightly less uniform.

While these tests required considerable time and covered several counts, the field was not covered sufficiently to draw general conclusions. However, these tests seemed to indicate that both long draft systems produced slightly better yarns than the ordinary system. One system seemed to be a little superior in producing strong yarns but the places were reversed in producing uniform yarns.

Southwick Hall

SERIES 33, No. 3 · *February, 1930*

Bulletin

of the

Lowell Textile Institute

LOWELL, MASS.

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1930

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6,600 2-'30 Order 7941

CALENDAR

1929–1930

September 19–20, Thursday–Friday . . .	Entrance Examinations
September 23–28, Monday–Saturday . . .	Re-examinations
September 26, Thursday, 9.00 A.M.	Registration for Freshmen
September 30, Monday	Registration for upper classmen Classes begin for Freshmen
October 1, Tuesday	Classes begin for upper classmen
November 26, Tuesday, 4.45 P.M.	Thanksgiving recess begins
December 2, Monday, 9.00 A.M.	Thanksgiving recess ends
December 20, Friday, 4.45 P.M	Christmas recess begins
January 6, Monday, 9.00 A.M.	Christmas recess ends
January 27, Monday	First term examinations begin
February 7, Friday	End of first term
February 10, Monday	Second term begins
April 16, Wednesday, 4.45 P.M.	Spring recess begins
April 21, Monday, 9.00 A.M.	Spring recess ends
May 26, Monday	Second term examinations begin
May 30, Friday	Memorial Day — Holiday
June 10, Tuesday	Commencement
June 12–13, Thursday–Friday	Entrance Examinations

1930–1931

September 11–12, Thursday–Friday . . .	Entrance Examinations
September 15–19, Monday–Saturday . . .	Re-examinations
September 18, Thursday, 9.00 A.M.	Registration for Freshmen
September 22, Monday	Registration for upper-class students Classes begin for Freshmen
September 23, Tuesday	Classes begin for upper-class students
October 13, Monday	Holiday — Observance of Columbus Day
November 25, Tuesday, 4.45 P.M.	Thanksgiving recess begins
December 1, Monday, 9.00 A.M.	Thanksgiving recess ends
December 19, Friday, 4.45 P.M.	Christmas recess begins
January 5, Monday, 9.00 A.M.	Christmas recess ends
January 19, Monday	First term examinations begin
January 30, Friday	End of first term
February 2, Monday	Second term begins
February 23, Monday	Holiday — Observance of Washington's Birthday
March 27, Friday, 4.45 P.M.	Spring recess begins
April 6, Monday, 9.00 A.M.	Spring recess ends
April 20, Monday	Holiday — Observance of Patriots' Day
May 25, Monday	Second term examinations begin
May 30, Saturday	Memorial Day — Holiday
June 9, Tuesday	Commencement
June 11–12, Thursday–Friday	Entrance Examinations

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Hermann Henry Bachmann . . . . 146 Parkview Avenue
Professor of Textile Design; in charge of Department of Design and Weaving

Lester Howard Cushing, A.B., Ed.M. . . . . 10 Walden Street
Professor of History and Economics; in charge of Department of Languages, History and Economics; Secretary of the Faculty; Director of Athletics and Physical Education

Herbert James Ball, S.B., B.C.S.. . . . . 119 Wentworth Avenue
Professor of Textile Engineering; in charge of Department of Textile Engineering and Accountancy

Gilbert Roscoe Merrill, B.T.E. . . . . 364 Varnum Avenue
Professor of Textiles; in charge of Department of Cotton Yarns and Knitting

Stewart Mackay . . . . North Chelmsford
Assistant Professor of Textile Design

John Charles Lowe . . . . 161 Dracut Street
Assistant Professor of Textiles

Martin John Hoellrich . . . . 30 Saxonia Avenue, Lawrence
Assistant Professor of Weaving

Elmer Edward Fickett, B.S. . . . . 162 Hovey Street
Assistant Professor of Analytical Chemistry

Frederick Steere Beattie, Ph.B.. . . . . 17 Osgood Street
Assistant Professor of Organic Chemistry

Harold Canning Chapin, Ph.D. . . . . 290 Pine Street
Assistant Professor of General Chemistry

Charles Lincoln Howarth, B.T.C. . . . . North Billerica
Assistant Professor of Dyeing

Percy Charles Judd, B.S. . . . . 272 Merrimack Street
Assistant Professor of Electrical Engineering

Harry Chamberlain Brown, S.B. . . . . 272 Merrimack Street
Assistant Professor of Physics and Mathematics

James Guthrie Dow, A.B. . . . . 11 Robbins Street
Assistant Professor of English

Cornelius Leonard Glen . . . . R. F. D. No. 1, Tewksbury
Assistant Professor of Finishing

A. Edwin Wells, B.T.E. . . . . . . 204 Franklin Street, Melrose Highlands
Assistant Professor of Mechanical Engineering

Russell Lee Brown, B.T.E. . . . . 59 Bradstreet Avenue
Assistant Professor of Textiles

Charles Harrison Jack . . . . R.F.D. No. 3, Nashua, N. H.
Instructor in Machine Shop Practice

Albert Greaves Sugden . . . . 673 School Street
Instructor in Weaving

Emma Elizabeth Whitney . . . . 137 Riverside Street
Instructor in Design and Decorative Art

Arthur Joseph Woodbury . . . . 41 Morey Street
Instructor in Cotton Yarns

Russell Metcalf Fox . . . . 359 Beacon Street
Instructor in Textile Design

Charles Arthur Everett, B.T.C. . . . . 38 Riverside Street
Instructor in Dyeing

Lester Whiting Ball, B.S. . . . . R.F.D. No. 2, Chelmsford, Mass.
Instructor in Mechanical Drawing
James Harrington Kennedy, Jr. . . . . 37 Roberts Street
Instructor in Wool Yarns and Sorting
William George Chace, Ph.B. . . . . 138 Llewellyn Street
Instructor in Chemistry
John Leslie Merrill, B.T.E. . . . . 2026 Middlesex Street
Instructor in Weaving
John Henry Skinkle, S.B. . . . . 78 Gates Street
Instructor in Chemistry
L. C. Tomlinson, E.E., M.S. . . . . 55 Tyler Park
Instructor in Mechanical Engineering
Clayton William Holmes, B.S. . . . . 468 Wilder Street
Instructor in Mathematics
Franz Evron Baker, B.T.E. . . . . 377 Westford Street
Instructor in Cotton Yarns

Elmer Percy Trevors . . . . 18 Rhodora Street
Assistant Instructor in Chemistry
Paul David Petterson . . . . 1386 Gorham Street
Assistant Instructor in Machine Shop Practice
Harmon Howorth . . . . 298 Pawtucket Street
Assistant Instructor in Cotton Yarns
Earle Raymond McLean . . . . 115 Mount Vernon Street
Assistant Instructor in Chemistry
Walter Archibald Robbins . . . . 102 South Loring Street
Assistant Instructor in Mechanical Drawing
Alfred John Carbone . . . . 10 Columbia Park, Haverhill
Assistant Instructor in Chemistry
Richard Omer Pero . . . . 298 Pawtucket Street
Assistant Instructor in Woolen Yarns

Walter Ballard Holt . . . . 37 Albert Street
Bursar
Ruth Foote, A.B., S.B. . . . . 7 Abbott Street, Nashua, N. H.
Registrar
Florence Moore Lancey . . . . 46 Victoria Street
Librarian
Helen Gray Flack, S.B. . . . . 445 Stevens Street
Secretary
Mona Blanche Palmer . . . . 685 Westford Street
Clerk
Ardean Kent Lance, S.B. . . . . 137 Riverside Street
Clerk

HISTORICAL SKETCH
of the
LOWELL TEXTILE INSTITUTE

By virtue of legislative acts of 1928, the Lowell Textile School became known as the Lowell Textile Institute in order to more clearly define the standing of the institution. This was the natural result of the development of the original ideas and policies of the trustees who founded the Lowell Textile School. The articles of incorporation were authorized by Chapter 475, Acts of 1895, and provided for a corporation to be known as the Trustees of the Lowell Textile School of Lowell, Massachusetts. The movement for the establishment of the school dates from June 1, 1891, but it was not opened for instruction until February 1, 1897.

In accordance with the acts of incorporation the Board of Trustees consisted of twenty permanent and self-perpetuating members, three-fourths of whom must be "actively engaged in, or connected with, textile or kindred manufactures." In addition, His Honor the Lieutenant-Governor, the Commissioner of Education of the State, the mayor, the president of the municipal council, the superintendent of schools of Lowell, and a representative of the textile council were members *ex-officio*. Legislative acts of 1905 and 1906 authorized the graduates of the school to elect four trustees serving for periods of four years each.

By virtue of the anti-aid amendment to the State Constitution, and by Chapter 274, General Acts of 1918, the property of the school was transferred on July 1, 1918, to the Commonwealth of Massachusetts, and the control and management of the school was vested in a Board of Trustees appointed by the Governor, "with all the powers, rights and privileges and subject to all the duties" of the original Board.

In locating the Institute at Lowell, which has been called the "Mother Textile City of America," considerable advantage is secured by close association with every branch of the industry, which utilizes almost every commercial fiber in the products of the great Merrimack Valley textile district.

Although the school was formally opened by Governor Roger Wolcott on January 30, 1897, in rented quarters in the heart of the city, it was not until January, 1903, that the first buildings of the present plant were ready for occupancy. On February 12, 1903, Governor John L. Bates dedicated the present buildings.

PURPOSE AND SCOPE OF THE INSTITUTE

The object of the establishment of the Institute as set forth in the original act was "for the purpose of instruction in the theory and practical art of textile and kindred branches of industry."

The plan was occasioned by the apparent crisis in the leading industry of New England, due to the rapid development of the manufacture of the coarser cotton fabrics in the southern States. It was believed that this crisis could be met only by a wider and more thorough application of the sciences and arts in the production of finer and more varied fabrics.

Following the general methods and systems found successful at the higher polytechnic institutes, it offers thorough instruction in principles of the sciences and arts applicable to textile and kindred branches of industry. The courses treat not only of the theory but also the application of these principles in the processes, on the machines and throughout all departments of industry involved in the successful manufacture, application and distribution of textile material in any form.

Though from the first the management has kept in view the clearly defined objective which called for the establishment of the Institute, it has developed its curriculum, its methods of instruction, and equipment as the needs of the industry arose. This objective will be kept constantly in view, and as new demands are presented an effort will be made to extend courses, equipment and floor space. The mechanical equipment of the Institute includes the best makes of textile machinery, and these machines, while built as they would be for regular work, are, as far as possible, adapted to the experimental work which is of particular value in such an institution as this.

Because of the breadth, grade and character of instruction given, and because of the standing and personnel of the instructing staff, the Institute has been placed by both Federal and State educational boards in the class of the higher technological schools of this country.

The United States Civil Service Commission recognizes graduates from the degree courses of this school as proper applicants for the examination to the various positions requiring a knowledge of applied science and engineering, as well as a knowledge of textile manufacturing, in the different departments of the government.

The day classes have been organized for those who can devote their entire time for three or more years to the instruction requisite in preparing to enter the textile industries. It has been found necessary to require of all such students educational qualifications equivalent to those given by a regular four-year course of a high school or academy of good standing.

The evening classes are held for about twenty weeks of the year, and are for those who are unable to attend the day courses. These are similar to the day courses, but are aimed especially to meet the needs of students working during the day in the mills and shops. For entrance to these classes an applicant should have the equivalent of a grammar school education. A detailed description of these courses and requirements is given in another Bulletin, which will be sent upon request.

BUILDINGS AND GROUNDS

The site is a commanding one, consisting of about 15 acres at a high elevation on the west bank of the Merrimack River. It extends to and overlooks the rapids of Pawtucket Falls, which was the first water power in America to be used on an extensive scale to operate power looms. It was contributed by Frederick Fanning Ayer, Esq., of New York City, and the Proprietors of the Locks and Canals on the Merrimack River.

Southwick Hall, the main building, fronting on Moody Street, was contributed by the Commonwealth of Massachusetts and Frederick Fanning Ayer, Esq., and is a memorial to Royal Southwick, a leading textile manufacturer, a public man of earlier days, and a maternal ancestor of Mr. Ayer. It includes a central mass 90 by 90 feet, having three stories and two wings 80 by 85 feet each with two stories and well-lighted basements. The building is pierced in the center by an arched way from which access is had to the wings and to the central courtyard. The northern wing is occupied by the General Offices, Engineering and Finishing Departments, and Library, while the southern wing is entirely occupied by the Chemistry and Dyeing Departments.

Kitson Hall, dedicated to the memory of Richard Kitson, was contributed by Charlotte P. Kitson and Emma K. Stott, his daughters; the Kitson Machine Company of Lowell, founded by Mr. Kitson, was also a generous contributor. This hall makes a right angle with Southwick Hall, is 70 by 183 feet, and has two stories and a basement. The first floor is occupied by the Cotton Yarn and Knitting Departments, while the basement contains the Mechanical and Electrical Engineering laboratories and the Machine Shop.

The Falmouth Street Building forms the third side of the quadrangle, and consists of three portions, one 60 by 75 feet, three stories, one 75 by 130 feet, three stories, and the head house 70 by 80 feet, three stories and basement. The building is occupied by the picker section of the Cotton Yarn Department, the Design and Power Weaving Department and by the Woolen and Worsted Yarn Department, and contains on the lower floors an equipment for the manufacture of wool yarn from the fleece to the finished yarn. The upper floors are occupied by a great variety of plain, dobby and Jacquard looms, and in a section of the building are the students' lockers and recreation rooms.

Colonial Avenue Building was erected in the summer of 1910 from plans prepared by the Engineering Department, which also had in charge the work of construction. The building completes the fourth side of the quadrangle, and in outward appearance corresponds to the architectural features of the other school buildings. It is a single-story building, and has the dimensions of 195 by 60 feet. Its interior is faced with cement brick made at the school during the progress of the

work. These serve to give light-reflecting walls which are advantageous for the work of the Wool Manufacturing, Cotton Finishing and Chemistry and Dyeing Departments that occupy this building. The funds for this building were provided by the State of Massachusetts.

The buildings are of modern mill construction adapted to educational uses and contain approximately 180,563 square feet.

CAMPUS

Through the generosity of Mr. Frederick Fanning Ayer the Institute has been provided with a campus and athletic field of about 3 acres. This has been carefully graded and laid out for baseball, football and track athletics.

To enclose this field the Alumni Class Fence has been partly built. It is made of forged iron sections supported between brick columns. Each section is contributed by a class, so that in the course of a few years this fence will entirely enclose the field.

On the upper floor of the Falmouth Street Building there has been provided a recreation room for the use of the students at such times as their attendance is not required in classes.

In the basement of this building there are rooms for the use of the athletic teams. Connected to these are showers and dressing rooms.

The upper hall of Southwick Hall has been equipped with gymnastic apparatus. Chest weights, wooden dumb-bells, Indian clubs, a set of traveling rings, a vaulting horse, parallel bars, a punching bag and several sets of foils and single sticks have been provided.

In order to be sure that no student having any dangerous physical weakness takes part in any athletic contest, all candidates for the various athletic teams are obliged to pass a satisfactory physical examination.

ENTRANCE REQUIREMENTS

Particular stress should be laid upon a thorough grounding in mathematics, including algebra, arithmetic and plane geometry, as these form the basis upon which the work of this school rests. While solid geometry is not required at the present time, the student will find a knowledge of this subject very valuable in his subsequent work, and is strongly recommended to include this subject as one of his electives. A preliminary course in science, including physics and chemistry, serves to prepare the student's mind for the higher branches of these subjects and their application, but neither will be considered as the equivalent of the courses in these branches given in the Institute.

Degree Courses

Candidates for admission to either of the degree courses must be graduates of a school approved by the New England College Entrance Certificate Board or by the Board of Regents of New York, and must present a certificate from the principal of the school last attended, reporting upon the subjects pursued and the points obtained according to the schedule of studies given hereafter. A total of fourteen points is required.

A point represents satisfactory work in a year's study in a specified subject in an approved secondary school.

Required Subjects	Points
Algebra A1	1
Algebra A2	1
English	4
Elementary French A (two years) or Elementary German A (two years)	2
Plane Geometry	1
History (American, Medieval and Modern, or English)	1
Physics	1
	11

Elective Subjects	Points
Chemistry	1
Elementary French (two years) or Elementary German (two years)	2
Advanced French or German (one year in addition to requirements of Elementary French A or Elementary German A)	1
History:	
American	1
Medieval and Modern	1
English	1
Latin	1
Mechanical Drawing	1
Mechanic Arts	1
Solid Geometry	1
Spanish	1
Trigonometry	1

An applicant may also be admitted on the basis of entrance examinations, in which case he must pass a sufficient number of the required subjects to make ten points and present certificates showing satisfactory courses in such of the elective subjects to make three additional points.

The objective of the elective requirements is to encourage greater breadth of preparation than that covered by the required branches. Certificates covering other subjects than those listed as elective will be entertained.

Diploma Courses

Candidates for admission to the diploma courses are accepted upon presentation of properly vouched certificates showing the completion of a regular four-year course in a high school or academy of reputable standing. The certificate must specify that the applicant has satisfactorily passed the required subjects.

A total of twelve points is required.

Required Subjects	Points
Algebra A1	1
Algebra A2	1
English	4
Plane Geometry	1
History (American, Medieval and Modern, or English)	1
Physics	1
	9

Elective Subjects

Three may be selected from the list under Degree Courses.

ENTRANCE EXAMINATIONS

All students who are unable to present a certificate for either the degree or the diploma courses must pass entrance examinations. Notification of intention to take these examinations must be made in writing at least a week before the date of the examinations. These will be held as follows: —

Thursday, June 12, 1930; Thursday, September 11, 1930; Thursday, June 11, 1931: —

Algebra, 9 A.M. to 11 A.M.
History, 11 A.M. to 1 P.M.
English, 2 P.M. to 4 P.M.

Friday, June 13, 1930; Friday, September 12, 1930; Friday, June 12, 1931: —

Plane Geometry, 9 A.M. to 11 A.M.
German or French, 11 A.M to 1 P.M.
Physics, 2 P.M. to 4 P.M.

Candidates failing to pass the June examinations are allowed to try again in September; those who cannot attend the June examinations may present themselves in September.

REQUIRED SUBJECTS FOR ENTRANCE

Algebra A1. — Derivation and use of simple formulas, graphical representation, the meaning and use of negative numbers, linear equations, with one or two unknown quantities, ratio and proportion, the essentials of algebraic technique, simple cases of exponents and radicals.

Algebra A2. — Numerical and literal quadratic equations in one unknown quantity, the binomial theorem for positive integral exponents, arithmetic and geometric series, simultaneous linear equations in three unknown quantities, simultaneous equations consisting of one quadratic and including graphical solutions, exponents and radicals.

Plane Geometry. — The usual theorems and constructions of good textbooks, including the general properties of plane rectilinear figures, the circle and the measurement of angles, similar polygons, areas, regular polygons, and the measurement of the circle. The solution of original problems and problems in mensuration of lines and plane surfaces.

English. — As secondary schools are following to a greater extent than heretofore the requirements of the College Entrance Examination Board, it is recommended that the applicant to this school conform to the suggestions of this Board relative to English composition and literature.

The examination consists of two parts, both of which are given at the same time.

(*a*) With the object of testing the student's ability to express his thoughts in writing clearly and correctly he will be required to write upon subjects familiar to him. Emphasis will be laid upon the composition, punctuation, grammar, idiom and formation of paragraphs. He will be judged by how well he writes rather than by how much he writes.

(*b*) The second part of the examination is prepared with the view of ascertaining the extent of the student's knowledge of good literature, and to test this examination questions will be based on the books adopted by the National Conference on Uniform Entrance Requirements. Any course of equivalent amount if made up of standard works will be accepted.

History. — Applicants may offer a preparation of American history, English history, or medieval and modern history.

In American history applicants should be familiar with the early settlements in America, the colonies, their government, the customs of the people, and events which led to the establishment of the United States. They should be informed concerning the causes and effects of the principal wars in which the country has been involved. They should be prepared to consider also questions requiring an elementary knowledge of civil government, as well as historical facts connected with the growth of this country up to the present time.

For the subject of English history or medieval and modern history the course given in any reputable secondary school should give proper preparation. A course extending over a full year with not less than three periods a week will be accepted.

Physics. — The applicant should be familiar with the fundamental principles of physics, particularly those considered under the headings of mechanics, heat, light, electricity and magnetism. Textbook instruction should be supplemented by lecture table experiments. Wherever possible, the student should pursue a laboratory course, but for the present no applicant will be conditioned in this subject if he has not been able to carry on a laboratory course. Where a laboratory course is offered by a secondary school, it should cover at least twenty-five of those experiments listed in the syllabus of the College Entrance Examination Board.

Modern Languages. — Required for degree courses only. It is expected that the work in these subjects has covered a period of at least two years of preparatory school training or the equivalent. Importance should be given to the ability to translate into good idiomatic English, but attention should also be paid to grammar and construction, that greater care may be used in translation.

Elementary German A. — The entrance examination is composed of two parts, both taken, however, at the same time.

(*a*) Translation of simple German prose into good idiomatic English.

(*b*) Questions to test proficiency in grammar, and simple English sentences to be rendered into German.

The requirements include the declension of articles, adjectives, pronouns and nouns; the conjugation and inflection of weak and strong verbs; the simpler uses of the subjunctive; the use of the modal auxiliaries; the prepositions and their uses; the principal parts of important verbs; and the elementary rules of syntax and word order.

Texts used in the language courses of any reputable high or preparatory school will furnish reading for translation. A list of texts is offered by the College Entrance Examination Board.

Elementary French A. — The entrance examination is composed of two parts, both taken, however, at the same time.

(*a*) Translation of simple French prose into good idiomatic English.

(*b*) Questions to test proficiency in grammar, and simple English sentences to be rendered into French.

The requirements include the principal parts, conjugation and inflection of the regular and the more common irregular verbs; the singular and plural forms of nouns and adjectives; the uses of articles and partitive construction; the forms and positions of personal pronouns; and the simpler uses of the conditional and subjunctive.

Suitable texts are suggested by the language courses of any reputable high or preparatory school and by the requirements of the College Entrance Examination Board.

Students who have pursued two years of elementary French as well as two years of elementary German may present one subject to cover two points in the required subjects, and the other to cover two points in the elective subjects.

ELECTIVE SUBJECTS

History. — If the applicant can present all three or any two branches of history specified he may include one as a required subject and the others in the list of elective subjects.

Chemistry. — Applicants must show evidence of their familiarity with the rudiments of chemistry. Any course given in a secondary school organized to present instruction by means of textbook or lecture, together with correlated laboratory work, will be considered as covering the requirements. The applicant's notebook with his original notes, including description of experiment, apparatus used, reactions, observations and deductions, must be accompanied by his instructor's certificate.

Importance will be placed upon manipulation and deductions as well as the general appearance and neatness of the notebook.

Solid Geometry. — The usual theorems and constructions of good textbooks, including the relations of planes and lines in space, the properties and measurement of prisms, pyramids, cylinders and cones; the sphere and spherical triangles. The solution of original problems and the applications of the mensuration of surfaces and solids.

Trigonometry. — The usual courses of instruction covered by the standard textbooks on plane and spherical trigonometry will prepare an applicant sufficiently to meet this requirement.

Mechanical Drawing. — The applicant must have pursued such a course in mechanical drawing that he will be familiar with the usual geometrical construction problems, projection of points, lines, planes and simple solids.

Importance is laid not only upon the accuracy with which the work is performed, but upon the general arrangement, appearance and care with which the plates are executed.

It should not be understood that work in this subject may be offered as the equivalent of the first term's work at the Institute.

Mechanics Arts. — The usual courses offered by properly equipped preparatory schools will be accepted as suitable fulfillment of this requirement. Work should include instruction in the handling of both wood and metal working tools in the more simple practices of these arts.

Elementary French B. — Applicants who enter for one of the three-year courses may present one year's work in French in a secondary school. Those who present themselves for examination in this subject should be familiar with the rudiments of grammar, and be able to translate simple French prose into good idiomatic English, also to translate into French English sentences, based on the French given for translation.

Elementary German B. — Applicants who enter for one of the three-year courses may present one year's work in German in a secondary school. What is stated in regard to French applies to those who may present German instead of French.

Advanced French or German. — In cases where applicants have pursued courses in French or German for more than two years, and have completed work which is more advanced than is included under elementary French or German, they may offer the additional year as an elective.

Spanish. — Students offering Spanish should be familiar with elementary grammar, the common irregular verbs, and be able to translate simple Spanish to English or English to Spanish. A preparation equivalent to three periods per week for two years will be acceptable.

Latin. — Students who have pursued one or more years of Latin may present this subject as an elective. Each year's work satisfactorily completed will be considered equal to one point.

ADVANCED STANDING

Candidates who may have received previous training in any of the subjects scheduled in the regular course will, upon presentation of acceptable certificates, be given credit for such work.

GRADUATE COURSES

Graduates of technical courses of other schools are invited to communicate with the president with reference to special courses in the textile studies. Previous training in the sciences and the engineering branches will usually reduce materially the time necessary to complete any of the courses at the Institute. The advantages

offered to such persons for special research work are unexcelled, and a most profitable course may be arranged.

COURSES OF INSTRUCTION

Degree Courses. — The four-year degree courses are as follows:

Textile Engineering.

Chemistry and Textile Coloring.

At the completion of these courses the degrees of Bachelor of Textile Engineering (B. T. E.) and Bachelor of Textile Chemistry (B. T. C.) are conferred.

Five options are offered in the Engineering Course, viz., general textile, cotton manufacturing, wool manufacturing, design, or sales option. Each of these courses is planned to train one in the fundamental principles of science found to be applicable in the particular fields of textile chemistry and textile engineering. It is maintained that for one to be successful in either of these important branches of industry a training is required as thorough and broad as that of any of the recognized branches of engineering or of applied science.

With this in mind these courses have been built of a secure framework of science and mathematics, and to it has been added the useful application of these branches in the broad textile field. With the direct purpose of laying a secure foundation in the training, a more extended preparatory course is first demanded, and subsequently in the school work more subjects of a general character are included, that narrowness of judgment and observation may not result by overstimulation of the technical development.

Diploma Courses. — The following courses extend over a period of three years and upon the completion of any one of these the diploma of the Institute is awarded:

Cotton Manufacture.

Wool Manufacture.

Textile Design.

These are the original courses offered at the Institute, arranged to require three years' study and to give the student as thorough a training as possible for his chosen field, stressing particularly the study of textiles.

COURSES FOR WOMEN

Although all classes are open to women, the courses which have appealed especially to their tastes have been textile designing and decorative art. Some have pursued courses in chemistry, and have added to their work in design some instruction in power weaving and finishing. These special courses have in general been followed for three years, and in some cases have led the students to positions either in the mill office or in some commercial lines that have been desirable and have offered congenial work.

Within the last few years the possibilities for women in certain branches of textile chemistry have become recognized, and it is believed that in the future the positions open to them will become more and more numerous.

GENERAL INFORMATION

Application for Admission. — A blank form of application for admission may be found at the end of this bulletin. This should be properly filled out by all applicants, whether entering upon certificate from a secondary school or presenting themselves for examination.

Freshman Registration. — Each freshman is expected to be in daily attendance beginning Thursday, September 18, at 9.00 A.M. and to follow the prepared program which will be placed in his hands. A program which is planned to acquaint the new student with the institution, its location and surroundings, its courses of instruction, its recreational activities and other phases of its life is arranged for the opening week. Unless arrangements for room and board are made previously, the first two days of the week may be used for this purpose. Physical examinations as well as certain other tests are given during this orientation period. Freshman week enables the student to secure the advantages which come from acquaintance with his surroundings, his instructors, the members of his class, student organiza-

tions, activities and customs. The overcrowding of the first week of classes with distractions is thus avoided.

Registration. — All upper classmen are required to register on or before the Monday of the week beginning the school year, and all students during the midyear examination period. For unexcused delay in registration a fee of $5 will be imposed.

Sessions. — The regular school sessions are in general from 9.00 A.M., to 12.50 P.M., and from 1.55 to 4.45 P.M., except Saturdays, when no classes are held. On Saturday afternoons the buildings are closed.

An hour plan designates the hours at which the various classes meet. This is rigidly adhered to, and the student is marked for his attendance and work as therein scheduled.

Attendance. — Attendance is required of all students on fourteen-fifteenths of all scheduled class exercises, provided they meet the requirements of their instructors for the omitted exercises. For every unexcused absence from any class exercise in excess of those allowed, a deduction from the mark obtained in the course in which the absences occurred will be made.

Advisers. — Advisers are appointed for all students, to be of such aid and assistance as they can both inside and outside of school hours. The head of the department in which a student is registered is adviser to upper-classmen, and instructors in charge of freshman classes act as advisers to freshmen.

Conduct. — Students are required to return to the proper place all instruments or apparatus used in experimental work, and to leave clean and in working order all machinery and apparatus with which they may experiment. All breakages, accidents or irregularities of any kind must be reported immediately to the head of the department or instructor in charge.

Irregular attendance, lack of punctuality, neglect of either school or home work, disorderly or ungentlemanly conduct or general insubordination are considered good and sufficient reasons for the immediate suspension of a student, and a report to the trustees for such action as they deem necessary to take.

It is the aim of the trustees so to administer the discipline of the Institute as to maintain a high standard of integrity and a scrupulous regard for trust. The attempt of any student to present, as his own, work which he has not performed, or to pass any examination by improper means, is regarded by the trustees as a most serious offense, and renders the offender liable to immediate suspension or expulsion. The aiding or abetting of a student in any dishonesty is also held to be a grave breach of discipline.

Any student who violates these provisions will be immediately suspended by the president, and the case reported at the following meeting of the trustees for action.

Examinations. — For first-year students examinations are held every five weeks, and these serve to inform the student concerning his standing and the progress made.

For students in upper classes examinations will be held during the eighth week of each term.

Final examinations are held at the end of each term.

In general, the examinations cover the work of the preceding term, but at the discretion of the instructor may include work of earlier terms.

Examinations for students conditioned in first-term subjects are held during the second term, and examinations for students conditioned in the second-term subjects are held in September following. Students requesting condition examinations at other than scheduled dates will be required to pay $5 for each examination so taken.

Any student who fails to complete a subject satisfactorily or to clear a condition at the time appointed, will be required to repeat the subject, and he cannot be admitted to subjects dependent thereon.

A student whose term's standing is as a whole so low that he cannot continue with profit the work of the next term will be required to leave, but he may return the following year to repeat such subjects as are required.

Daily work and regularity of attendance are considered in making up the reports of standing.

Records and Reports of Standing. — During each term informal reports are sent to parents or guardians of all students under age, and to all students; and at the end of each term formal reports are made.

The daily work of the student forms an important part of his record, and no pupil will be awarded the diploma or degree unless this portion of his record is clear.

Books are prescribed for study, for entry of lecture notes and other exercises, and are periodically examined by the lecturers. The care and accuracy with which these books are kept are considered in determining standing.

Thesis. — Each candidate for the degree of the Institute must file with the head of the department in which the thesis is taken, and not later than May 15, a report of original investigation or research, written on a good quality of paper, 8½ by 11 inches, with one-inch margin at left, and one-half inch at right, of each page; such thesis to have been previously approved by the head of the department in which it is made.

For all candidates for the diploma this requirement will be optional on the part of the Institute.

Library and Reading Room. — That the students may have surroundings conducive to reading and study a moderate-sized reading room with library tables and chairs has been provided. The library shelves contain textile, art, engineering and scientific publications. These are increased from time to time as new technical books of value to textile students are issued from the press. The leading textile papers are kept on file for ready reference.

FEES, DEPOSITS, ETC.

Tuition Fee. — The fee for the day course is $150 per year for residents of Massachusetts. For non-residents the fee for all courses is $200 per year. The fee for students from foreign countries is $300 per year.

Three-fifths of the fee is charged for a single term. Each term's tuition is payable during the first week of that term. Students failing to make this payment at the specified time will be excused from classes until satisfactory explanation and arrangements for payment can be made. *No bills will be sent.* After payment is made no fee or part thereof can be returned, except by special action of the trustees.

Special students pay, in general, the full fee, but if a course be taken involving attendance at the school during a limited time, application may be made to the president for a reduction.

Students entering from Massachusetts are required to file with the Bursar a statement signed by either town or city clerk, stating that the applicant's father is a legal resident of Massachusetts.

Athletic Fee. — An athletic fee of $15 is due and payable at the time of the first payment of tuition.

Deposits. — For all first-year students a minimum deposit of $25 is required to cover the cost of breakage, supplies, apparatus and chemicals used in the Chemical Laboratory, the unexpended balance to be returned to the student at the end of the year. For all students in second, third and fourth years taking work in Chemistry and Dyeing Laboratories a deposit of $25 for the first term and $25 for the second term is required.

Students taking Machine Shop will be required to make deposit of $15 to cover cost of materials, supplies and breakage. Included in this charge is a kit of tools which is essential to the work and which becomes the personal property of the student. The unexpended balance will be returned at the end of the year.

Students not taking Chemistry Laboratory or Machine Shop will be required to make a deposit of $10 each year to cover general breakage. The unexpended balance will be returned at the end of the year.

All deposits must be made before students can be admitted for laboratory work.

Rooms and Board. — Students from a distance, requiring rooms and board in the city, may, if they desire, select same from a list which is kept at the Institute. The cost of rooms and board in a good district is $12 per week and upwards.

Books and Materials. — Students must provide their own books, stationery, tools, etc., and pay for any breakage or damage that they cause. The above fee includes free admission for any day students desiring to attend any of the evening classes in which there is accommodation.

All raw stock and yarn furnished to the students, and all the productions of the Institute, remain or become its property, except by special arrangement; but each student is allowed to retain specimens of yarn or fabrics that he has produced, if mounted and tabulated in accordance with the requirements of the department. It is understood that the department may retain such specimens of students' work as they may determine.

Lockers are provided for the use of the students, sufficiently capacious to contain clothing, books and tools.

No books, instruments or other property of the Institute are loaned to the students to be removed from the premises except by special permission.

Summary of Expenses per Year

Tuition (residents of Massachusetts)	$150
Tuition (residents of other States)	200
Tuition (foreigners)	300
Chemistry laboratory deposit (1st year)	25
Chemistry laboratory deposit (2d, 3d and 4th years)	50
Athletic fee	15
Machine shop deposit	15
General breakage fee (This applies to students who do not take chemistry or machine shop.)	10
Books and supplies (Books and supplies for the first year cost about $80, second and third year $35, and fourth year $50, thus averaging about $50 per year for the four years.)	50

SCHOLARSHIPS AND PRIZES

The Massachusetts Charitable Mechanic Association Scholarship. — The Massachusetts Charitable Mechanic Association has offered six scholarships of $250 each which are for the purpose of defraying school expenses of such students as may be selected by a committee composed of a representative from the association, one from the Board of Trustees and the President of the Institute.

Herbert A. Currier Scholarship. — Herbert A. Currier, of the class of 1906, has offered a prize of $100 to a student who may be selected by the faculty of the Institute, and in making the selection the following conditions will be considered: scholastic standing, financial need, and ability in promoting student activities in school life. The scholarship will be awarded to a member of the sophomore, junior or senior class.

Textile Colorist Award. — The Textile Colorist, Inc., has offered a prize of $100 to be awarded to a member of the graduating class whose thesis, based upon his personal researches and experiences, is of the greatest practical value to the dyeing, bleaching or textile finishing industries.

Louis A. Olney Book Prize. — Prizes in the form of books are awarded each year to the successful candidate on graduation day. The conditions in detail are as follows: —

First. — Ten dollars to the student taking the regular Chemistry and Textile Coloring Course who shall be considered as having attained the highest scholarship in first-year chemistry.

Second. — Five dollars to the student taking the regular Chemistry and Textile Coloring Course who shall be considered as having attained the second highest scholarship in first-year chemistry.

Third. — Ten dollars to the regular student of the Chemistry and Textile Coloring Course who shall be considered as having obtained the highest scholarship during his second year.

Cotton Yarn Department

Fourth. — Five dollars to the regular student of the Chemistry and Textile Coloring Course who shall be considered as having attained the second highest scholarship during his second year.

Fifth. — Twenty dollars to the regular student in the Chemistry and Textile Coloring Course who shall present the best thesis preparatory to graduation.

The above-mentioned sums are to be invested in books which may be selected after graduation. In case no one is considered worthy of any particular scholarship prize, or if there is no competition, the same may be withheld. The decision in such case shall rest with the judges.

The National Association of Cotton Manufacturers Medal. — The National Association of Cotton Manufacturers offers a medal to that member of the graduating class who, during his course, shall have attained the highest standing in special subjects required by the vote of the association.

STUDENT ACTIVITIES AND ORGANIZATIONS

School Publications. — The Text is issued bi-weekly and it contains news pertaining to activities in the Institute as well as information concerning alumni. The Pickout is an annual publication in charge of a manager and editor selected from the senior class. The board is composed of representatives from the various classes.

Fraternities. — There are four fraternities, three of which are national and one is local. They afford opportunity for social life desired in a college career.

Musical and Dramatic Clubs. — The past four years the students have had a well-organized orchestra and glee club which have given very enjoyable programs within and without the city. This offers an opportunity for pleasure and profit to students who enjoy music either vocal or instrumental. The Dramatic Club gives annually a theatrical program at the Lowell Auditorium. Appropriation is made from the profits to the treasury of the Athletic Association.

Professional Clubs. — A Student Section of the American Society of Mechanical Engineers holds meetings regularly in accordance with requirements of the national organization. The Student Section of the American Society of Dyers and Colorists hold meetings at which papers are delivered or speakers come from outside the school organization.

Honor Society. — To degree candidates who have maintained a high scholarship for three years' work, or who have met with certain similar requirements, is accorded the honor of membership in the society Tau Epsilon Sigma. Relatively a membership in this society corresponds to that in some of the well known honor societies of the liberal arts and scientific colleges. It requires constant attendance and application to the work of the course for any student to reach the scholarship level entitling him to this membership.

Honor Roll. — The President's List includes upper classmen taking a regular course who have a general average of eighty percent and no deficiencies.

Co-operative Society. — This society is maintained for the benefit of students who desire to purchase supplies and materials for use in connection with their work. It is operated under the direction of a manager and assistant manager and one or more clerks. The general business policy is under the supervision of a member of the faculty. Students who join the society are entitled to discount privileges when purchasing from the society and from certain firms in the city of Lowell.

Alumni Association. — The Alumni Association of the Institute holds its annual meeting and banquet in May of each year.

The membership of the association is composed of graduates of the day courses and is open to any non-graduate who has attended the Institute for at least one year.

Officers for the Year 1929–30

Edwin D. Fowle, '24, *President*
Frank L. McCool, '10, *Vice-President*
Arthur A. Stewart, '00, *Secretary-Treasurer*

Communications should be addressed to Arthur A. Stewart, Lowell Textile Institute.

Ex-Officio Members of Executive Committee

Edward M. Abbot, '04
Henry A. Bodwell, '00
Thomas T. Clark, '10
Ralph K. Hubbard, '11
Frank L. McCool, '10
T. Ellis Ramsdell, '02
Royal P. White, '04

Executive Committee

15 Members

Philip H. Warren, '05
Alexander Campbell, '23
James F. Dewey, '04
Leonard S. Farr, '08
Russell T. Fisher, '14
Charles H. Forsaith, '20
Olin D. Gay, '08
Arthur J. Hennigan, '06
Brackett Parsons, '20
Everett B. Rich, '11
Dean W. Symmes, '22
Ernest D. Walen, '14
J. Milton Washburn, '21
A. Edwin Wells, '20
Stanley H. Wheelock, '05

SUBJECTS OF INSTRUCTION

In the column headed "Hours of Exercise" the numbers represent for each particular subject the total hours required in school for a period of fifteen weeks.

The letter and number which follow the subjects indicate the department in which the subject is given and the number of the subject in that department. For detailed description of the same, see page 34.

The departments are indicated as follows: —

Textile Engineering	B	Cotton Yarns	F
Chemistry and Dyeing	C	Woolen and Worsted Yarns	G
Textile Design and Power Weaving	D	Finishing	H
Languages and History	E		

By referring to the letter and number indicated under "Preparation" the student can ascertain what subjects are necessary in order that he may have a clear understanding of the subject which he is scheduled to take.

First Year

First Term

(Common to all Courses)

	Hours of Exercise
Elementary Chemistry C–10	105
English E–10	45
Mathematics B–10	45
Mechanical Drawing B–13	135
Physics B–11	75
Physical Education	30
Textile Design and Cloth Analysis D–10	90

Second Term

	Course IV	Course VI
Elementary Chemistry C–10	90	45
Elementary German E–11	30	–
English E–10	45	45
Machine Drawing B–14	–	105
Mathematics B–10 or B–10a	45	75
Mechanism B–12 or B–12a	45	75
Physical Education	30	30
Qualitative Analysis C–12 or C–12a	150	30
Stoichiometry C–13	30	–
Technology of Fibers C–11, F–10 and G–10	60	60
Textile Design and Cloth Analysis D–10	–	60

For second-term subjects in Courses I, II, and III, see pages 21, 23, 25.

Course I. — Cotton Manufacture

The Cotton Manufacturing Course is designed for students contemplating a career in the manufacturing of cotton yarns, cloth or allied industries, and wishing to devote but three years to instruction at the Institute.

During the first term the studies are common to all courses, and include instruction in mathematics, mechanical drawing, physics, textile design and elementary chemistry.

During the second term, lectures in organic chemistry are given followed by lectures in textile chemistry and dyeing the second year. The work in mechanism serves as a basis for all future machine and mechanical work, and is followed by steam engineering, electricity and mill engineering. The course in textile designing, cloth analysis and cloth construction includes lectures on plain and fancy weaves and Jacquard, the analysis of all commercial fabrics, and designs for the same.

Power weaving is taken up during the second and third years. Commencing with lectures and practice upon plain looms, the instruction continues with dobby, box-loom, and Jacquard weaving.

A course in knitting taken during the third year includes the manufacture of flat goods, hosiery and underwear. Considerable laboratory practice accompanies the lecture work, giving the students actual working knowledge of a wide range of knitting machines. Instruction in the finishing of cotton fabrics is given by lectures and laboratory work, and requires considerable work on standard machines in the laboratory. Textile testing, also given in the third year, instructs the student in standard methods for physical testing of textile material.

In the second term of the first year, instruction in the technology of fibers is given. The student is instructed regarding cotton growing areas and cotton cultivation. The commercial cottons and their peculiarities, cotton classing and the involved system by means of which cottons are marketed, are also considered.

The work of the second year in the Cotton Yarn Department continues the study started in the first year, stressing particularly cotton carding, that is, the operations of opening, picking, carding, combing, drawing and roving. The instruction consists of lectures supplementing available textbooks. A considerable time is spent in the laboratory studying cotton fibers and classing, followed by operating and adjusting the various machines studied during the year.

The third year's work continues that of the second year, with detailed study of spinning, spooling, twisting and winding. Another course gives instruction in mill organization, balancing and arranging machinery in the mill. Finally, a brief course is given in the use of the microscope and camera in studying various problems in cotton manufacture. Laboratory practice supplements the lecture course, giving practical operation, adjustment and observation of the machines studied. Advanced laboratory work illustrates the methods of study and analysis of the more general and complex problems such as are usually handled in the laboratory of a textile plant.

During both the second and third years, particular attention is given to the preparation of the various reports in order that the student may learn proper methods for presenting data and conclusions resulting from mill studies and tests.

During the third year, each student makes some original study, usually of a technical nature. He must make a formal report of this study satisfactory to the faculty before receiving his diploma.

For detailed description of the subjects see page 34.

Course I. — Cotton Manufacture

[For first term see page 19]

First Year. Second Term. (Hours of Exercise)

Elementary Chemistry C–10	45	Physical Education	30
English E–10	45	Technology of Fibers C–11, F–10, G–10	60
Machine Drawing B–14a	90	Textile Design and Cloth Analysis D–10	135
Mathematics B–10b	45		
Mechanism B–12	75		

Second Year. First Term

Cotton Yarn Manufacture F–20	225	Textile Chemistry and Dyeing Lect. C–21	30
Physics B–22a	45	Textile Design and Cloth Analysis D–20	75
Power Weaving D–22	120		
Steam Engineering B–24	30		

Second Year. Second Term

Cotton Yarn Manufacture F–20	255	Textile Design and Cloth Analysis D–20	60
Physics B–22a	45		
Power Weaving D–22	165		

Third Year. First Term

Cotton Finishing H–31	75	Mill Engineering B–34a	30
Cotton Organization F–32	60	Power Weaving D–31	120
Cotton Yarn Manufacture F–30	135	Textile Testing G–31	30
Economics E–30	45	Thesis F–34.	
Electricity B–31a	30		

Third Year. Second Term

Cotton Finishing H–31	75	Marketing B–46	30
Cotton Research Laboratory F–33	15	Power Weaving D–31	120
Cotton Yarn Manufacture F–30	165	Thesis F–34.	
Knitting F–31	120		

Course II. — Wool Manufacture

The course on wool manufacturing is arranged for those who contemplate a career in the manufacture of woolen or worsted fabrics, and can devote but three years to the school work. It includes instruction on all of the varied processes employed in manipulating the wool fiber to produce yarn and cloth, namely, sorting, scouring, carding, combing, spinning, designing, weaving, dyeing and finishing. The work is carried on by lectures, recitations and practical work in the laboratories.

Following the first term of the first year, which is common to all courses, the student taking technology of fibers becomes acquainted not only with the various kinds of wool and trade terms applied to them, but also with other commercial fibers, viz., cotton, silk, jute, hemp, flax, etc., used in the textile industry. He is at the same time taught the application of these fibers and the general processes of manufacturing each into a yarn.

Beginning with the second year the details of manipulating wool from the grease to the finished yarn is taken up for close study. This includes the spinning of woolen yarn, also worsted yarn, by both the English and the French systems. The intermediate processes of sorting, scouring, carding, combing and top-manufacturing are taken in detail and in proper sequence.

The general chemistry of the first year is followed by a lecture course in the second year on textile chemistry and dyeing.

Textile design, cloth analysis and construction are continued from the first year throughout the course, the work being applied especially to woolen and worsted goods. Weaving on power looms commences in the second year and continues through the third.

Lectures on finishing commence with the third year and are augmented by extensive practice with the machines in the Finishing Department.

Work in the Engineering Department extends throughout all three years, and includes mechanical drawing, steam engineering and electricity. The practical application of the principles studied in these subjects is brought out forcibly in the work on mill engineering, where mill design and construction are considered. A short course covering methods employed in the testing of fibers, yarns, and cloths, together with laboratory work in the manipulation of certain physical apparatus, is given in the third year.

For detailed description of the subjects see page 34.

Course II. — Wool Manufacture

[For first term see page 19]

First Year. Second Term. (Hours of Exercise)

Elementary Chemistry C–10	45	Physical Education	30
English E–10	45	Technology of Fibers C–11, G–10, F–10	60
Machine Drawing B–14a	90	Textile Design and Cloth Analysis D–10	135
Mathematics B–10b	45		
Mechanism B–12	75		

Second Year. First Term

Physics B–22a	45	Textile Chemistry and Dyeing Lect. C–21	30
Power Weaving D–22	90	Top Manufacture G–20	240
Steam Engineering B–24	30		
Textile Design and Cloth Analysis D–21	90		

Second Year. Second Term

Physics B–22a	45	Top Manufacture G–20	285
Power Weaving D–22	135		
Textile Design and Cloth Analysis D–21	60		

Third Year. First Term

Economics E–30	45	Power Weaving D–31	120
Electricity B–31a	30	Textile Testing G–31	30
Finishing H–30	75	Yarn Manufacture G–30	195
Mill Engineering B–34a	30		

Third Year. Second Term

Finishing H–30	75	Power Weaving D–31	90
Knitting F–31	105	Yarn Manufacture G–30	225
Marketing B–46	30	Thesis.	

Course III. — Textile Design

The general course in textile design is planned to meet the demand of young men for a technical training in the general processes of textile manufacturing, but with particular reference to the design and construction of fabrics. To this end a foundation is laid in the first year by instruction in the elementary principles of designing, decorative art and weaving. That he may later in the course pursue to advantage instruction in yarn manufacturing, weaving, dyeing, finishing and some engineering problems, a foundation course in mechanics, mathematics and chemistry is laid. As the student is required to pursue courses in the yarn departments, both cotton and wool, he acquires a knowledge of the manufacture of cotton yarns from the bale to the yarn, and of woolen and worsted yarns from the fleece through the varied processes of manufacturing woolen yarn or worsted yarn by both the French and Bradford systems.

Throughout his entire course he receives instruction in design, cloth analysis and construction of all the standard cloths, viz., trouserings, coatings, suitings, blankets, velvets, corduroys, plushes, etc. This is followed by advanced work in Jacquard designing and weaving, which serves not only to acquaint the student with the many kinds of cotton, woolen, worsted and silk fabrics of figured design, but stimulates and develops any artistic talent he may possess. Decorative art becomes an important part of the work of the second and third years.

The course in general inorganic and organic chemistry of the first year leads to the subject of textile chemistry and dyeing in the second year.

Power weaving commences with the second year and continues throughout the course, and work on all types of looms is required.

During the third year the student receives instruction in the finishing of cotton goods and woolen and worsted cloths. This instruction is given by means of lecture and laboratory work.

The engineering subjects given in the second and third years are intended to acquaint the student with such general knowledge as will be of assistance should he be called upon in later life to be a mill manager, or should his subsequent progress lead to some executive position in the operation of a textile plant.

For detailed description of the subjects see page 34.

Course III. — Textile Design

[For first term see page 19]

First Year. Second Term. (Hours of Exercise)

Elementary Chemistry C–10	45	Physical Education	30
English E–10	45	Technology of Fibers C–11, F–10, G–10	60
Machine Drawing B–14a	90	Textile Design and Cloth Analysis D–10	135
Mathematics B–10b	45		
Mechanism B–12	75		

Second Year. First Term

Cotton Yarn Manufacture F–20a	120	Textile Chemistry and Dyeing Lect. C–21	30
Cotton Yarn Manufacture F–30a	30	Textile Design and Cloth Analysis D–20, 21	195
Physics B–22a	45		
Power Weaving D–22	75		
Steam Engineering B–24	30		

Second Year. Second Term

Cotton Yarn Manufacture F–20a	45	Textile Design and Cloth Analysis D–20, 21	195
Cotton Yarn Manufacture F–30a	30	Top Manufacture G–20	90
Physics B–22a	45		
Power Weaving D–22	120		

Third Year. First Term

Cotton Finishing H–31	75	Textile Testing G–31	30
Electricity B–31a	30	Woolen and Worsted Finishing H–30	75
Mill Engineering B–34a	30	Worsted Yarn Manufacture G–30	90
Power Weaving D–31	60		
Textile Design and Cloth Construction D–30	135		

Third Year. Second Term

Cotton Finishing H–31	75	Woolen and Worsted Finishing H–30	75
Marketing B–46	30	Worsted Yarn Manufacture G–30	60
Power Weaving D–31	105	Thesis.	
Textile Design and Cloth Construction D–30	180		

Course IV. — Chemistry and Textile Coloring

The four-year course in Chemistry and Textile Coloring, leading to the degree of B.T.C., is especially intended for those who wish to engage in any branch of textile chemistry, textile coloring, bleaching, finishing or the manufacture and sale of the dyestuffs or chemicals used in the textile industry. The theory and practice of all branches of dyeing, printing, bleaching, scouring and finishing are taught by lecture work supplemented by a large amount of experimental laboratory work and actual practice in the dyehouse and finishing room.

The underlying theories and principles of chemistry are the same, no matter to what industry the application is eventually made. Furthermore, no industry involves more advanced and varied applications of the science of chemistry than those of the manufacture and application of the coal-tar coloring matters. In addition, the textile colorist must consider the complex composition of the textile fibers, and the obscure reactions which take place between them and the other materials of the textile industry.

During the first year general chemistry, including both inorganic and organic, is taught by lectures and laboratory work, and this is supplemented during the second term by qualitative analysis and stoichiometry.

Advanced inorganic chemistry, as well as advanced organic chemistry, is studied during the second and third year as a continuation of the elementary chemistry of the first year, and much time is spent upon quantitative analysis, industrial chemistry, and textile chemistry and dyeing.

The foundation work in general chemistry is continued during the third year with courses in physical chemistry, organic laboratory work and analytical work. The subject of industrial chemistry is introduced, and much time is devoted to advanced textile chemistry, dye testing, color matching, calico printing and woolen, worsted and cotton finishing.

The fourth year is characterized by an endeavor to present certain subjects of a more applied nature in such a manner that the student's reasoning power and ability to apply the knowledge gained during the first three years may be developed to the fullest extent. The subject of engineering chemistry is introduced, and the work in the Dyeing and Analytical Laboratories is applied as far as possible to the actual requirements of the factory chemist and colorist. The student is given a thorough course in microscopy, photomicrography and the use of the various instruments, such as the spectroscope, ultra-microscope, polariscope, tintometer, etc., which often prove of vital importance in the advanced study of textile chemistry. During this fourth year the student devotes much time in the Organic Laboratory in the manufacture of dyestuffs. This is followed by such research work or original investigation as time will permit. Upon this he must present a satisfactory thesis, or report, before receiving his degree.

For detailed description of the subjects see page 34.

Course IV. — Chemistry and Textile Coloring

[For first year see page 19]

Second Year. First Term. (Hours of Exercise)

Subject	Hours	Subject	Hours
Advanced German E–21	30	Stoichiometry C–20	15
Adv. Inorganic Chemistry C–23	30	Textile Chemistry and Dyeing Lab. C–22	105
Mathematics B–20a	45	Textile Chemistry and Dyeing Lect. C–21	30
Physics B–22a	45		
Quantitative Analysis C–25	195		
Steam Engineering B–24	30		

Second Year. Second Term

Subject	Hours	Subject	Hours
Advanced German E–21	30	Stoichiometry C–20	15
Adv. Inorganic Chemistry C–23	30	Textile Chemistry and Dyeing Lab. C–22	150
Adv. Organic Chemistry C–24	30	Textile Chemistry and Dyeing Lect. C–21	30
Mathematics B–20a	45		
Physics B–22a	45		
Quantitative Analysis C–25	150		

Third Year. First Term

Subject	Hours	Subject	Hours
Adv. Organic Chemistry Lect. C–34	30	Economics E–30	45
Adv. Textile Chemistry and Dyeing Lab. C–32	120	Industrial Chemistry C–31	30
Adv. Textile Chemistry and Dyeing Lect. C–32	30	Quantitative Analysis C–30	165
		Technical German C–35	30
		Woolen and Worsted Finishing H–30	75

Third Year. Second Term

Subject	Hours	Subject	Hours
Adv. Textile Chemistry and Dyeing Lab. C–32	75	Organic Laboratory C–36	105
Adv. Textile Chemistry and Dyeing Lect. C–32	15	Physical Chemistry C–33	30
Economics E–30	45	Quantitative Analysis C–30	120
Industrial Chemistry C–31	30	Technical German C–35	30
		Woolen and Worsted Finishing H–30	75

Fourth Year. First Term

Subject	Hours	Subject	Hours
Adv. Textile Chemistry and Dyeing Lab. C–45	120	Photography C–46	15
Adv. Textile Chemistry and Dyeing Lect. C–45	30	Physical Chemistry C–44	45
Engineering Chemistry C–42	30	Quantitative Analysis C–48	15
Engineering Chemistry Laboratory C–43	30	Report Writing C–49	15
Organic Laboratory C–41	90	Technical German C–40	30
		Textile Testing G–31	30
		Thesis C–50	75

Fourth Year. Second Term

Subject	Hours	Subject	Hours
Adv. Textile Chemistry and Dyeing Lab. C–45	105	Microscopy and Photomicroscopy C–47	45
Adv. Textile Chemistry and Dyeing Lect. C–45	15	Organic Laboratory C–41	105
Engineering Chemistry C–42	15	Physical Chemistry C–44	15
Marketing B–46	30	Report Writing C–49	15
		Technical German C–40	30
		Thesis C–50	150

Course VI. — Textile Engineering

This course is the four-year general textile course leading to the degree of Bachelor of Textile Engineering (B.T.E.), and aims especially to fit men, in the broadest possible manner, to meet the increasing demands of every branch of the textile industry for men with combined textile and technical preparation. The magnitude and scope of the textile and allied industries fully justify the most thorough technical training possible for all who aspire to leadership in this field.

The student is first thoroughly grounded in those fundamental principles of science upon which all industrial and engineering work rests. The foundation of his textile and technical training is in the subjects of mathematics, physics, chemistry, drawing, mechanics, mechanism, and technology of fibers, and their practical application.

Instruction is given in all of the various branches of textile manufacturing through lectures, recitations and laboratory work. A large proportion of his time is spent in well-equipped textile departments where he studies and operates all of the machinery required in the conversion of cotton and wool fiber into yarns and fabrics. This includes cotton, wool and worsted yarn manufacturing, designing, weaving, knitting, dyeing and finishing. In his last year the course in textile testing acquaints the student with the methods for determining the physical properties of textile fibers, yarns and fabrics.

To properly equip the student to meet the varied engineering problems which confront the mill manager or executive, or to so train him that he may enter those industries closely allied to the textile, instruction is given by lecture and laboratory practice in the several branches of engineering.

Steam engineering considers the problems involved in steam generation and distribution for power, heating and manufacturing purposes, includes the testing of laboratory and power plant equipment, and leads to the design of power plants. The course in electrical engineering includes a study of the generation and transmission of electrical power, the testing of direct and alternating current machinery, and is intended to acquaint the student with modern practice.

Mill engineering familiarizes the student with mill design, construction, heating, lighting, humidification and fire protection. The arrangement of machinery and buildings for most efficient production and economical power distribution is also studied in detail.

The broadening effect of such subjects as English, language, industrial history and economics is carried still further in this course by carefully planned courses in business administration, accounting, cost accounting, business and patent law.

During the fourth year the student is required to conduct an original investigation of some textile or allied problem, and to submit the results in the form of a satisfactory thesis before receiving his degree.

For the student who may desire the breadth of technical training which this course offers, but who wishes to specialize in either cotton or wool manufacturing, two options are offered. In these optional courses the student's entire textile time is devoted to the study of that particular fiber which he elects.

During the past few years a demand has come from the distributing or marketing branches of the textile business for men with a four years' technical training. With the idea of offering courses which may better prepare graduates to meet this new call, the new Sales Option Course is offered.

There are also requests for a four-year Design Course which, while majoring in Textile Design, includes other subjects that help to make a broader course than the one of three years' duration. For this purpose the Design Option Course is offered. Like the other courses outlined, these will be subject to changes to meet new demands.

For detailed description of subjects, see page 34.

Course VI. — Textile Engineering (General Course)

[For first year see page 19]

Second Year. First Term. (Hours of Exercise)

Machine Drawing B–21	105	Textile Design and Cloth Analysis D–20, 21, or Language E–20	45
Machine Shop B–23	90	Wool Yarn Manufacture G–20	120
Mathematics B–20	60		
Physics B–22	75		
Textile Chemistry and Dyeing Lecture C–21	30		

Second Year. Second Term

Applied Mechanics B–25	45	Mathematics B–20	60
Advanced Textile Mechanism B–26, or Language E–20	45	Physics B–22	75
Cotton Yarn Manufacture F–20a	120	Power Weaving D–22	90
		Wool Yarn Manufacture G–20	90

Third Year. First Term

Applied Mechanics B–30	45	Power Weaving D–31	60
Cotton Yarn Manufacture F–30a	60	Wool Yarn Manufacture G–30	90
Economics E–30	45	Woolen and Worsted Finishing H–30	75
Electrical Engineering B–31	75		
Heat Engineering B–32	75		

Third Year. Second Term

Cotton Yarn Manufacture F–30a	60	Mill Engineering B–34	90
Economics E–30	45	Wool Yarn Manufacture G–30	90
Electrical Engineering B–31	75	Woolen and Worsted Finishing H–30	75
Heat Engineering B–33	90		

Fourth Year. First Term

Accounting B–40	90	Mill Engineering B–42	105
Cotton Organization F–32	90	Textile Testing G–31	30
Electrical Engineering B–41	75	Thesis	90
Microscopy B–44	45	Electives B–47	

Fourth Year. Second Term

Business Administration B–43	90	Mill Engineering B–42	45
Cotton Finishing H–31	105	Power Plants B–45	60
Electrical Engineering B–41	75	Thesis	90
Knitting F–31a	30	Electives B–47	
Marketing B–46	30		

Course VI. — Textile Engineering (Cotton Option)

[For first year see page 19]

Second Year. First Term. (Hours of Exercise)

Cotton Yarn Manufacture F–20a	165	Textile Chemistry and Dyeing Lecture C–21	30
Machine Drawing B–21	105	Textile Design and Cloth Analysis D–20, or Language E–20	45
Machine Shop B–23	45		
Mathematics B–20	60		
Physics B–22	75		

Second Year. Second Term

Advanced Textile Mechanism B–26, or Language E–20	45	Cotton Yarn Manufacture F–20a	180
Applied Mechanics B–25	45	Mathematics B–20	60
		Physics B–22	75
		Power Weaving D–22	120

Third Year. First Term

Applied Mechanics B–30	45	Heat Engineering B–32	75
Cotton Finishing H–31	75	Power Weaving D–31	60
Cotton Yarn Manufacture F–30a	75	Textile Design and Cloth Analysis D–20	75
Economics E–30	45		
Electrical Engineering B–31	75		

Third Year. Second Term

Cotton Finishing H–31	75	Heat Engineering B–33	90
Cotton Yarn Manufacture F–30a	120	Mill Engineering B–34	90
Economics E–30	45	Textile Design and Cloth Analysis D–20	30
Electrical Engineering B–31	75		

Fourth Year. First Term

Accounting B–40	90	Textile Design and Cloth Analysis D–30	30
Cotton Organization F–32	90	Textile Testing G–31	30
Electrical Engineering B–41	75	Thesis	105
Microscopy B–44	45	Electives B–47	
Mill Engineering B–42	60		

Fourth Year. Second Term

Business Administration B–43	90	Power Plants B–45	60
Electrical Engineering B–41	75	Textile Design and Cloth Analysis D–30	30
Knitting F–31a	120	Thesis	75
Marketing B–46	30	Electives B–47	
Mill Engineering B–42	45		

Course VI. — Textile Engineering (Wool Option)

[For first year see page 19]

Second Year. First Term. (Hours of Exercise)

Machine Drawing B–21	105	Textile Design and Cloth Analysis D–21, or Language E–20	45
Machine Shop B–23	45	Wool Yarn Manufacture G–20	165
Mathematics B–20	60		
Physics B–22	75		
Textile Chemistry and Dyeing Lecture C–21	30		

Second Year. Second Term

Advanced Textile Mechanism B–26, or Language E–20	45	Mathematics B–20	60
Applied Mechanics B–25	45	Physics B–22	75
		Power Weaving D–22	120
		Wool Yarn Manufacture G–20	180

Third Year. First Term

Applied Mechanics B–30	45	Power Weaving D–31	60
Economics E–30	45	Wool Yarn Manufacture G–30	150
Electrical Engineering B–31	75	Woolen and Worsted Finishing H–30	75
Heat Engineering B–32	75		

Third Year. Second Term

Economics E–30	45	Wool Yarn Manufacture G–30	150
Electrical Engineering B–31	75	Woolen and Worsted Finishing H–30	75
Heat Engineering B–33	90		
Mill Engineering B–34	90		

Fourth Year. First Term

Accounting B–40	90	Textile Testing G–31	30
Electrical Engineering B–41	75	Thesis	105
Microscopy B–44	45	Electives B–47	
Mill Engineering B–42	60		
Textile Design and Cloth Analysis D–30	120		

Fourth Year. Second Term

Business Administration B–43	90	Power Plants B–45	60
Electrical Engineering B–41	75	Textile Design and Cloth Analysis D–30	90
Knitting F–31a	30	Thesis	105
Marketing B–46	30	Electives B–47	
Mill Engineering B–42	45		

Course VI. — Textile Engineering (Design Option)

[For first term, first year, see page 19]

First Year. Second Term. (Hours of Exercise)

Elementary Chemistry C–10	45	Qualitative Analysis C–12a	30
English E–10	45	Technology of Fibers C–11, F–10, G–10	60
Machine Drawing B–14	30	Textile Design and Cloth Analysis D–10	135
Mathematics B–10	75		
Mechanism B–12	75		
Physical Education	30		

Second Year. First Term

Cotton Yarn Manufacture F–20a	165	Textile Design and Cloth Analysis D–20, 21	105
Machine Drawing B–21	45	Language or Textile Design	45
Mathematics B–20	60		
Physics B–22	75		
Textile Chemistry and Dyeing Lecture C–21	30		

Second Year. Second Term

Advanced Mechanism B–26, or Language E–20	45	Power Weaving D–22	75
Cotton Yarn Manufacture F–20a	75	Textile Design and Cloth Analysis D–20, 21	90
Mathematics B–20	60	Wool Yarn Manufacture G–20	105
Physics B–22	75		

Third Year. First Term

Advanced Physics	75	Wool Yarn Manufacture G–30	90
Economics E–30	45	Woolen and Worsted Finishing H–30	75
Power Weaving D–31	75		
Textile Design and Cloth Analysis D–30	165		

Third Year. Second Term

Economics E–30	45	Wool Yarn Manufacture G–30	90
Power Weaving D–31	105	Woolen and Worsted Finishing H–30	75
Textile Design and Cloth Analysis D–30	210		

Fourth Year. First Term

Accounting B–40	90	Textile Design and Cloth Analysis	45
Jacquard Weaving	90	Textile Styling and Merchandising	75
Marketing B–46	60	Textile Testing G–31	30
Microscopy B–44	45	Thesis	90

Fourth Year. Second Term

Business Administration B–43	90	Textile Design and Cloth Analysis	165
Cotton Finishing H–31	105	Thesis	90
Power Weaving	75		

Course VI. — Textile Engineering (Sales Option)

[For first term, first year, see page 19]

First Year. Second Term. (Hours of Exercise)

Elementary Chemistry C–10	45	Qualitative Analysis C–12a	30
English E–10	45	Technology of Fibers C–11, F–10, G–10	60
Machine Drawing B–14	30	Textile Design and Cloth Analysis D–10	135
Mathematics B–10	75		
Mechanism B–12	75		
Physical Education	30		

Second Year. First Term

Cotton Yarn Manufacture F–20a	165	Textile Design and Cloth Analysis D–20, 21	105
Machine Drawing B–21	45	Language or Textile Design	45
Mathematics B–20	60		
Physics B–22	75		
Textile Chemistry and Dyeing Lecture C–21	30		

Second Year. Second Term

Advanced Mechanism B–26, or Language E–20	45	Power Weaving D–22	75
Cotton Yarn Manufacture F–20a	75	Textile Design and Cloth Analysis D–20, 21	90
Mathematics B–20	60	Wool Yarn Manufacture G–20	105
Physics B–22	75		

Third Year. First Term

Advanced Physics	75	Wool Yarn Manufacture G–30	90
Economics E–30	45	Woolen and Worsted Finishing H–30	75
Power Weaving D-31	75		
Principles of Salesmanship	45		
Textile Design and Cloth Analysis D–30	120		

Third Year. Second Term

Economics E–30	45	Textile Design and Cloth Analysis D–30	165
Power Weaving D-31	45	Wool Yarn Manufacture G–30	90
Principles of Advertising	60	Woolen and Worsted Finishing H–30	75
Sales Organization and Administration	45		

Fourth Year. First Term

Accounting B–40	90	Microscopy B–44	45
Business Psychology	45	Textile Styling and Merchandising	75
Jacquard Weaving	90	Textile Testing G–31	30
Marketing B–46	60	Thesis	90

Fourth Year. Second Term

Business Administration B–43	90	Psychology of Advertising and Selling	45
Cotton Finishing H–31	105	Statistics	45
Foreign Trade and Economic Geography	45	Thesis	120
Knitting F-31a	75		

SUBJECTS OF INSTRUCTION

TEXTILE ENGINEERING DEPARTMENT — B

Mathematics — B-10. Preparation: Admission Requirements. The work in the first term consists of plane trigonometry, logarithms, and instruction in the use of the slide-rule. Right and oblique triangles are solved by means of natural and logarithmic functions, and the various algebraic relations among the trigonometric functions are proved and used in identities and equations. Significant figures and the use of approximate data in calculations are also discussed.

In the second term the following topics are taken up: graphical and mathematical solution of quadratic and simultaneous equations, theory of equations, partial fractions, Naperian logarithms, equations of the straight line, equations of various curves, differentiation of algebraic functions, and applications of the derivative. [Course VI.]

Mathematics — B-10a. Preparation: Admission Requirements. This subject in the first term is identical with B-10. In the second term, the following topics are given: graphical solutions of equations, theory of equations, partial fractions, Naperian logarithms, and equations of the straight line and various curves. [Course IV.]

Mathematics — B-10b. Preparation: Admission Requirements. This subject in the first term is identical with B-10a but excludes some of the topics given in the second term of B-10a. [Courses I, II, III.]

Physics — B-11. Preparation: Admission Requirements. Taken simultaneously with B-10. This subject is required as a necessary preparation for all courses, and sixty hours of lecture and recitation time are devoted to it during the first term of the first year. The fundamental principles of this subject are considered absolutely essential to a thorough understanding of the operation of all machinery, textile or otherwise. Some of the topics treated in this course are linear and angular velocity, uniform and accelerated motion, mass, momentum, inertia, effect of force in producing motion, centrifugal force, work, power, energy, principle of moments and its applications, parallelogram and triangle of forces with applications, resolution and composition of forces, the mechanical principles represented by the wheel and axle, differential pulley block, common pulley blocks, jackscrew, worm and wheel, and inclined plane.

Laboratory

This course is supplementary to the lecture course and gives the student an opportunity to apply the knowledge gained in the lecture course by performing various experiments. [All courses.]

Mechanism — B-12. Preparation: B-10 and B-11. This subject is also deemed to be one of those absolutely essential to every student's preparation for the work of the following years. Whereas the principles studied are of general application, textile machinery in particular furnishes an unusually large variety of specific examples, and frequent reference is made to these in the development of the course. Some of the important topics covered are gearing and gear train design, belting and pulley calculations, cone and stepped pulley design, cam design, linkages, epicyclic gear trains, and intermittent motion devices.

Laboratory

This work is supplementary to the course in Mechanism. Some of the experiments and tests made in this course are as follows: —

Determination of coefficient of friction; proof of principle of work; efficiency test of various hoisting and lifting appliances, such as tackle and fall, worm block, differential and triplex blocks, jackscrews, wedges, etc.; efficiency tests on belt transmission, including measurement of belt tensions, coefficient of friction, slip, etc. [Courses I, II, III, VI.]

Mechanism — B-12a. Preparation: B-10 and B-11. This course is similar in content to Mechanism B-12. The material has been revised and reduced so as to fit more nearly the needs of the students taking Course IV. No laboratory is given with this course. [Course IV.]

Mechanical Drawing — B-13. Preparation: Admission Requirements. Taken simultaneously with B-11. This course is taken during the first year, and consists of work in the drawing room supplemented by lectures. This subject is considered of the greatest importance as a preparation for the student's future work, and the practical usefulness of drawing of this character is fully emphasized. The course is systematically laid out covering in order the following divisions: —

Care and use of drawing instruments; geometrical constructions; lettering; elements of projections and descriptive geometry; isometric projection; developments with practical applications; sketching practice on machine details. [All courses.]

Machine Drawing — B-14. Preparation: B-13. This course is the continuation of Mechanical Drawing, and is pursued throughout the second term of the first year. The work is wholly of a practical character, and includes sketching from the textile machinery details and working scale details, tracing and blue-printing. The rudiments of machine design to supplement the work in strength of materials are also given. [Course VI.]

Machine Drawing — B-14a. Preparation: B-13. This course is similar to B-14, but not so extensive, and is given to students electing the manufacturing courses. [Courses I, II, III.]

Mathematics — B-20. Preparation: B-10. This subject is a continuation of the first year subject B-10, and extends throughout the second year of the engineering course. In the first term the following topics are treated: — derivatives and differentials, the circle, parabola, ellipse, hyperbola, indefinite integrals, summation by integration and applications of integration. In the second term the topics are: differentiation of transcendental functions, methods of integration, centers of gravity, moments of inertia, empirical formulas, and nomographic charts. [Course VI.]

Mathematics — B-20a. Preparation: B-10a. This subject is a continuation of the work of the first-year subject B-10a. A study of the derivative is followed by the differentiation of algebraic functions and applications of the derivative to maximum and minimum and rate problems. Other topics treated are the circle, parabola, ellipse, hyperbola, indefinite integrals, summation by integration, areas, volumes and pressures. [Course IV.]

Machine Drawing — B-21. Preparation: B-13. The work in Machine Drawing is devoted to working detail drawings of textile machinery and advanced graphical mechanism problems. The data for all of these problems are in every case taken directly from some of the textile machines that the students meet in other departments. [Course VI.]

Physics — B-22. Preparation: B-10 and B-11. This subject lays the foundation for later work in engineering and chemistry and also explains the general application of the laws and principles of physics. Instruction, consisting of lectures, demonstrations, and recitations, is given for three hours per week during the second year. The topics taken up the first term are: — thermometry, measurement of heat, change of state, expansion, transfer of heat, humidity, hydrostatics, elements of hydraulics, the vernier, kinetic energy, circular motion, harmonic motion, wave motion and sound.

The second term is devoted to the study of light, magnetism, and electricity. Some of the topics are: — nature and propagation of light, reflection and refraction lenses, the telescope and microscope, the spectroscope, color sensation, double refraction, magnetism, electrostatics, fundamental laws of direct currents and electrolysis.

Laboratory

Laboratory work consisting of a two-hour period per week accompanies the class work in this subject and is planned to illustrate precise methods for measuring various physical quantities. [Course VI.]

Physics — B-22a. Preparation: B-10a and B-11. This subject consists of the same topics as B-22 but does not contain any laboratory work. [Courses I, II, III, IV.]

Machine Shop Practice — B-23. Preparation: B-11 and B-12. Systematic instruction is given in the most approved methods of machine shop practice, the

object being to familiarize the student with the proper use of hand and machine tools, and the characteristics of the different materials worked. Particular attention is given to the form, setting, grinding and tempering of tools and the mechanism of the different machines involving certain speeds, feeds, etc. The course is so planned that the instruction in each typical operation shall conform as nearly as possible to commercial machine-shop practice on textile machinery. The list of tools which appears under "Equipment" in this Bulletin gives an idea of the scope of the work, which includes chipping and filing, tool grinding and tempering, straight and taper turning, screw cutting, drilling and boring, planer work; milling machine work, including gear cutting. [Course VI.]

Steam Engineering — B-24. Preparation: B-10, B-11, B-12. This course consists of thirty lectures given in the first term of the second year. Its aim is to give those students who do not take the Engineering Course a general knowledge of thermodynamics, the steam engine, steam turbine and gas engine and their auxiliaries, and waste heat reclamation. [Courses I, II, III, IV.]

Applied Mechanics — B-25. Preparation: B-10, B-11, B-20. This course is divided into two parts: Graphic Statics and Strength of Materials. The first eight weeks of the semester which is devoted to Graphic Statics consists of the study of mathematical and graphical solutions for any system of forces. Centers of gravity and funicular polygons are introduced followed by roof and bridge truss problems under various conditions of dead, live, wind, and snow loading.

During the second half of the semester and during all the following semester, this course deals with Strength of Materials. So far as time permits, such topics as stress, strain, methods of testing materials, bending moments, shearing force, beam design, torsion, design of shafts, compound beams and columns, combined stresses, and like subjects, are considered.

This subject is preparatory to the work in Mill Engineering of both the third and fourth years, at which time its practical value and application are clearly demonstrated. [Course VI.]

Advanced Textile Mechanism — B-26. Preparation: B-12, B-20, B-21. The first part of this course is a continuation of the elementary course in Mechanism (B-12); the second part takes up the study of the more complicated mechanisms used in textile machinery. Methods of mathematical and graphical analysis are applied to existing textile mechanisms, and problems of design are also included. [Course VI.]

Applied Mechanics — B-30. Preparation: B-25. This is a continuation of Applied Mechanics B-25, and is given during the first term of the third year. [Course VI.]

Electrical Engineering — B-31. Preparation: B-22. The elementary principles of electricity and magnetism are considered in the lecture course of physics. Their development and application are taken up in this course in a detailed study of the magnetic and electric circuits during the first period of the first term. The second period is devoted to a study of the principles of direct current machinery. The laboratory work consists of a study of technical electrical measurements and dynamo-electric machinery, determining for the latter their operating characteristics.

The second term is devoted entirely to a study of the principles of alternating current circuits, including vector representation, effective values, power, series and parallel circuits. The laboratory work consists of a study of technical electrical measurements, some meter calibration including that of watt-hour meters and a study of alternating current circuits using electrical measuring instruments. [Course VI.]

Electricity — B-31a. Preparation: B-22a. This is a short course given in the third year of the manufacturing courses, and consists of thirty lectures covering briefly and in a general way the theory of direct and alternating current generators and motors. [Courses I, II, III.]

Heat Engineering — B-32. Preparation: B-10, B-11, B-12, B-20. The purpose of this course is to familiarize the student with the principles of elementary thermodynamics, the properties of steam, mechanical mixtures and combustion of fuels. The course consists of thirty exercises given in the first term of the third

year. The lectures and recitations are supplemented with illustrative problems assigned for home preparation.

LABORATORY

The principles underlying the subjects of steam engineering, hydraulics and thermodynamics are demonstrated in a practical manner in the work in the Engineering Laboratory, given three hours per week. Greater importance is attached to the development of initiative and responsibility in the student than the mere accomplishment of a large number of carefully planned tests. The character of this work is indicated by the following list of experiments and tests: —

Calibration of scales, tanks, gauges, inductors and counters; barrel, separating, and throttling calorimeter tests; heat exchange tests; boiler inspection and measurement; flue gas analysis; dynamometer tests; ejector and injector tests; Rankin's efficiency, actual thermal efficiency and duty tests; expansion of pipes, radiation and pipe covering tests; boiler test; trap tests, feed water heating tests; steam, triplex and centrifugal pump tests. [Course VI.]

Heat Engineering — B-33. Preparation: B-32. This course is a continuation of B-32, and consists of forty-five hours of lectures and recitations given in the second term of the third year of the Textile Engineering course. The subjects developed are the kinematics of reciprocating steam engines, steam turbines and gas engines. Special attention is given to the mechanical principles on which the steam engine operates, with detail discussion of the valve gear and governing devices, and the various diagrams used for studying the same. Consideration is given to the underlying heat theory and to the details of construction of the various parts of the machines. During the latter part of the course the historical development, classification and types of turbines and gas engines are discussed.

LABORATORY

The character of the work in the Engineering Laboratory, given three hours per week during the second half of the third year, is indicated by the following list of experiments: —

Boiler inspection and measurement; Rankin's efficiency, actual thermal efficiency and duty tests; boiler test; valve setting by measurement and by indicator; condenser test; non-condensing and condensing engine and turbine tests; heating and ventilating fan tests; lap and butt riveted joint test; nozzle test; gas engine test; flow of air and air compressor tests. [Course VI.]

Mill Engineering — B-34. Preparation: B-12, B-20, B-21, B-25. Mill Engineering, as presented in thirty lectures during the third year of the Textile Engineering course, consists of a discussion of the following topics: the selection of a site for a manufacturing plant; the investigation of the subsoils for the footing course of the foundation; wood, concrete and sheet steel piling; design of walls, beams, floors, windows, doors, stairways and roofs.

Sixty hours of drawing-room and laboratory practice are devoted to plane surveying, contour plotting, cut and fill calculations, setting of batter boards, alignments of shafting and the study from blue-prints of slow-burning construction. [Course VI.]

Mill Engineering — B-34a. Preparation: B-10, B-12, B-21. Mill Engineering, as presented in thirty lectures during the third year of the diploma courses, is largely general in its nature and includes only parts of Course B-34. [Courses I, II, III.]

Accounting — B-40. Preparation: B-10 and E-30. The purpose of the course in accounting is to acquaint the student with modern methods of accounting for mercantile and manufacturing businesses. At the same time it gives him a much-needed knowledge of such common elementary business transactions as are involved in the use of checks, drafts, notes, vouchers, bonds and stocks.

It is not the purpose of the course to make the student a proficient bookkeeper or accountant, but the nature of the work necessitates a basic knowledge of double-entry bookkeeping and of the functions of ledger accounts. This is developed in practice in the following manner: During the summer preceding the fourth year the student is required to work up a simple bookkeeping set, thus saving valuable

time during the school year and effectively preparing the ground for the instruction work.

The course includes a study of the balance sheet and profit and loss statement, and their construction in proper form. Attention is given to the principles of balance sheet valuation, and to such topics as depreciation in all its phases, sinking fund reserves, and the accounting for bond and stock issues.

One-half of the time scheduled for accounting is devoted to a study of Cost Accounting. It is designed to give the student a knowledge of the best cost methods in use at the present time, and involves a thorough discussion of methods of handling and accounting for raw materials, direct labor, and the distribution of overhead expenses. [Course VI.]

Electrical Engineering — B–41. Preparation: B–31. During the first term a detailed study of the alternator is made, with particular stress on generation of three-phase currents. Methods of predetermination of alternator regulation are taken up and at least one method compared with laboratory test. Parallel operation of alternators with accompanying instruments and devices are studied in classroom and laboratory. The single phase, three-phase and Scott transformers are considered in turn and their various methods of connecting to line and alternators are systematically studied.

In the second term the induction motor and generator are studied with their particular adaptability to the textile industry. The principal starting devices for this motor are thoroughly taken up. The synchronous motor is studied particularly in relation to its ability to correct power factor. In all the work outlined above, the main features are illustrated profusely in classroom demonstrations and laboratory exercises.

Mill Illumination

Fourteen lectures and six laboratory periods. The various factors entering into the design of lighting installations are carefully considered. Costs and estimates, safety and production, are included in the course.

The laboratory exercises include the study and applications of the photometer, Macbeth Illuminometer and foot-candle meter. The concluding work is a design of a lighting installation for a typical mill room, using the school laboratories for this purpose. [Course VI.]

Mill Engineering — B–42. Preparation: B–11, B–12, B–21, B–23. This work, given in the fourth year of the Textile Engineering course, covers a wide range of subjects and is of the most practical character possible. All of the student's previous work in engineering and his knowledge of the textile processes are here brought together in the consideration of the larger problems of mill design, construction and organization. After a detailed study has been made of the most modern types of mill buildings, including all calculations and drawings, the student is given the problem of laying out and completely designing a textile mill so far as time permits.

The modern methods of power transmission and the proper arrangement of textile machinery are also given careful consideration. The problems are in every case taken from actual conditions in mills already built or in process of construction. The question of mill heating, ventilation, lighting, humidification and fire protection is also studied, and the time spent in the drawing room enables the student to work out nearly all of the more important problems involved in the design of an entire textile mill plant. The close relation existing between proper plant design and economical production is also considered. [Course VI.]

Business Administration — B–43. Preparation: B–10 and E–30. In recognition of the great advances which have been recently made towards better methods of management, and of the possibilities which may result from its application to the textile industry, a course in business administration has been established to enable the student to understand and apply the principles and details of modern management. The instruction in this course begins with a consideration of the factory location and design and their effect on efficiency of production, after which the proper form of organization for manufacturing establishments is discussed in detail, together with organization charts and records.

This is followed by a study of the details of the work of the various departments, such as purchasing, manufacturing, planning, etc., and includes such topics as purchasing systems, storekeeping, perpetual inventories, warehousing, scheduling, routing, tracing, timekeeping, motion studies, time studies, mnemonic symbolizing, graphical records, wage systems, etc. Consideration is also given to the important relation of psychology to efficient management. The work is further supplemented by visits to plants where methods of production and management can be observed at first hand by the students.

Business Law

Under this subject are given lectures, supplemented by the use of a suitable text, on the law governing contracts, negotiable instruments, sales, bills of lading, real estate and corporation. [Course VI.]

Microscopy — B–44. Preparation: B–22. This subject consists of the study of animal and vegetable fibers by means of the microscope and its accessories. It includes sectioning and mounting, measurements of diameter and twist, and the use of polarized light in the study and identification of fibers. [Course VI.]

Power Plants — B–45. Preparation: B–33. This course, which consists of lectures and supervised problem work given during the second term of the fourth year, takes up the fundamental consideration involved in the planning of a power plant for a textile mill. Standard textbooks are used in connection with the lectures. Problems of chimney design, combustion and heat balances are first considered. A power plant is actually planned, the choice of type and size of units for certain conditions being given particular attention. [Course VI.]

Textile Marketing — B–46. This subject covers the problems of marketing textile products, with particular emphasis upon the ultimate consumer. The course will survey the principal marketing channels and marketing methods. Attention is directed to the possibilities of demand creation and demand control, especially through market and style research. Current changes in marketing organization of the industry will be studied and reviewed. [All courses.]

Electives — B–47. Students in the fourth year of the Textile Engineering course will be permitted to elect certain textile subjects as substitutes for part of the time scheduled for engineering subjects. Thus a student is offered an opportunity for specialized study along such lines as will prove most beneficial to him at that time. The selection of elective studies is subject to the approval of the head of the Textile Engineering department and to the possibility of arranging for the same. [Course VI.]

CHEMISTRY AND DYEING DEPARTMENT — C

Elementary Chemistry (Inorganic and Organic Chemistry) — C–10. Preparation: Admission Requirements. Instruction in Elementary Chemistry extends through the first year, and includes lectures, recitations and a large amount of individual laboratory work on the following subjects: —

Inorganic Chemistry

Non-Metallic Elements. — Their occurrence, properties, preparation, chemical compounds, etc.

Metallic Elements. — Their occurrence, properties, metallurgy, chemical compounds, etc.

Theoretical Chemistry. — Fundamental laws and the theories of chemistry including chemical action, chemical combination, combining weights, atomic weights, chemical equations, acids, bases, salts, Avogadro's law, molecular weights, formulæ, valence, periodic law, etc.

Throughout this course special attention is given to the relationship which exists between the science of chemistry and the properties of the materials used in the various industries and the chemical reactions depended upon for the maintenance of industrial processes.

The laboratory work of this course includes the experimental study of the above subjects and also a preliminary study of the qualitative detection of the more common metals and non-metals, preparatory to Course C–12.

Organic Chemistry

This course includes a general survey of the fundamental principles of Organic Chemistry, also a study of the hydrocarbons and their derivatives from the point of view of their structure, preparation and uses. This work, although elementary in character, is of sufficient breadth to prepare the student understandingly for the general lectures upon Coal Tar dyestuffs which are given in Course C–21.

Chemical Technology of Fibers — C–11. The outline of the lecture course which is given during the second term of the first year is as follows: —

Technology of Vegetable Fibers. — Cotton, linen, jute, hemp, china grass. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Animal Fibers. — Wool, mohair, silk. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Artificial Fibers. — Study of the various forms of artificial silk, the process of manufacture, their properties and action with chemicals, acids and heat.

Operations Preliminary to Dyeing. — Bleaching of cotton and linen; wool-scouring; bleaching, fulling and felting of wool; carbonizing; silk-scouring and bleaching; action of soap.

The bleaching of cotton cloth, yarn and raw stock is studied at length with detailed description of the various forms of kiers and machinery used; also the action of the chemicals used upon the material, and the various precautions that must be taken in order to insure successful work.

Under this heading is also included an exhaustive study of the reagents used in the emulsive wool-scouring process, and their action upon the fiber under various conditions; also the most successful of the solvent methods for degreasing wool.

Water and its Application in the Textile Industry. — Impurities present, methods for detection, their effect during the different operations of bleaching, scouring, dyeing and printing, and the methods used for their removal or correction.

The important subject of boiler waters is also studied under this heading, with a full discussion of the formation of boiler scale, its disastrous results, and the methods by which it may be prevented. [All courses.]

Qualitative Analysis — C–12. Preparation: C–10 taken simultaneously. Qualitative Analysis is studied during the second term of the first year. The work consists of conferences and laboratory work. The student must become familiar with the separations and the detections of the common metals and acids by the analysis of a satisfactory number of solutions, salts, alloys and pigments. At intervals during the term short laboratory tests are given as well as the regular written examinations.

No pains are spared to make the course as valuable to the student as possible, and to encourage only thorough and intelligent work.

When sufficiently advanced, students take up the examination of various products with which the textile chemist must be familiar such as testing mordanted cloths, pigments and the various dyeing reagents.

During the latter part of this course a certain amount of time is devoted to the preliminary operations of quantitative analysis, such as the precipitation and washing of such substances as barium sulphate, magnesium ammonium phosphate and calcium oxalate, although no weighings or actual determinations are made.

A student's marks in this subject depend as much upon the neatness and care used in manipulation as upon the actual results obtained. [Course IV.]

Qualitative Analysis — C–12a. Preparation: C–10. This subject, given two hours per week during the second term to the students of the Textile Engineering Course, is a continuation of the first term work in General Chemistry. [Course VI.]

Stoichiometry — C–13. Preparation: B–10, C–10. This subject is taken two hours each week during the second half of the first year. The application of the metric system is thoroughly studied, and problems are worked involving the expansion and contraction of gases, determination of empirical formulæ, com-

bining volume of gases and chemical calculations, especially those of quantitative analysis. [Course IV.]

Stoichiometry — C–20. Preparation: C–13. This is a continuation of Stoichiometry C–13, and is taken during the second year as an adjunct to Quantitative Analyis. [Course IV.]

Textile Chemistry and Dyeing — C–21. Preparation: C–10, B–12, B–14. Mordants and Other Chemical Compounds Used in Textile Coloring and Classified as Dyestuffs. — Theory of mordants, their chemical properties and application, aluminum mordants, iron mordants, tin mordants, chromium mordants, organic mordants, tannin materials, soluble oil, fixing agents, leveling agents, assistants, and numerous other compounds, not dyestuffs, that are extensively used in the textile industry.

Under this heading are included the definitions of various terms and classes of compounds used by textile colorists, such as color lakes, pigments, fixing agents, developing agents, mordanting assistants, mordanting principles and leveling agents.

Theory of Dyeing. — A discussion of the chemical, mechanical, solution and absorption theories, and the various views that have been advanced by different investigators of the chemistry and physics of textile coloring processes.

Under this heading are discussed the general methods of classifying dyestuffs and the definitions of such terms as textile coloring, dyeing, textile printing, substantive and adjective dyestuffs, monogenetic and polygenetic dyestuffs.

Natural Organic Coloring Matters. — Properties and application of indigo, logwood, catechu or cutch, Brazil wood, cochineal, fustic, tumeric, madder, quercitron bark, Persian berries, and other natural dyestuffs that have been used within recent years by textile colorists.

Mineral Coloring Matters. — Under this heading are discussed the properties of such inorganic coloring matters and pigments as chrome yellow, orange and green, Prussian blue, manganese brown and iron buff.

Artificial Coloring Matters. — General discussion of their history, nature, source, methods of manufacture, methods of classification and their application to all fibers.

Special study of basic coloring matters, phthalic anhydride colors, including the eosins and phloxines; acid dyestuffs, Janus, direct cotton, sulphur and mordant colors, including the alizarines and other artificial coloring matter requiring metallic mordants; mordant acid and insoluble azo colors, developed on the fiber; reduction vat colors, aniline black and other artificial dyestuffs not coming under the above heads.

As each class of dyestuffs is taken up, the details of the methods of applying them upon all the different classes of fabrics and in all the different forms of dyeing machines are thoroughly discussed; also the difficulties which may arise in their application, and the methods adopted for overcoming them.

Machinery Used in Dyeing. — A certain amount of time is devoted to the description of the machinery used in various processes of textile coloring which is supplemented as far as possible by the use of charts, diagrams and lantern slides.

Most of the important types of dyeing machines are installed within the dyehouse of the school, and the students can be taken directly from the lecture room and shown the machines in actual operation. [All courses.]

Dyeing Laboratory — C–22. Preparation: C–21 taken simultaneously. Besides lectures and recitations upon the subject of Textile Chemistry and Dyeing, practical laboratory work is required. By the performance of careful and systematic experiments the student learns the nature of the various dyestuffs and mordants, their coloring properties, their action under various circumstances, and the conditions under which they give the best results. The more representative dyestuffs of each class are applied to cotton, wool and silk, and each student is obliged to enter, in an especially arranged sample book, a specimen of each of his dye trials with full particulars as to the conditions of experiment, percentage of compounds used, time, temperature of dye bath, etc.

For convenience and economy most of the dye trials are made upon small skeins or swatches of the required materials, but from time to time students are required

to dye larger quantities in the full-sized dyeing machines which are described elsewhere.

By the use of a small printing machine the principles of calico printing are illustrated, and by means of the full-sized dyeing machines and vats the practical side of the subject is studied. It is the constant endeavor of those in charge to impart information of a theoretical and scientific character that will be of value in the operation of a dyehouse. [Course IV.]

Advanced Inorganic Chemistry — C–23. Preparation: C–10. The whole subject of Inorganic Chemistry is reviewed during the second year, and many advanced topics are introduced which were necessarily omitted from the first-year course in General Chemistry. [Course IV.]

Advanced Organic Chemistry — C–24. Preparation: C–10. In this course, which consists of lectures and recitations, the principles of organic substitution and synthesis are thoroughly discussed and as many illustrations are used as time will permit, particularly such as are applied in the arts. The aliphatic series of hydrocarbons and their derivatives are studied for about twenty weeks, the remainder of the time being devoted to the benzine series. The aim of the course is to lay a broad foundation for the study of the chemistry of the artificial dyestuffs. Students are required to work out problems in the synthesis of various compounds, in order to become familiarized with equation writing. [Course IV.]

Quantitative Analysis.— C–25. Preparation: C–12, C–13. The object of this course is to teach the fundamental principles of quantitative analysis, and to give the student an opportunity of acquiring skill in manipulating the special apparatus used in analytical procedure.

Typical gravimetric methods are taught the first term. The samples analyzed comprise salts, minerals and ores. Electrochemical analysis is carried out with the aid of a modern type of apparatus designed for rapid work.

The work of the second term consists of volumetric methods. A number of ores and commercial products, carefully chosen, are analyzed so as to give the student a varied experience.

The laboratory work is supplemented by lectures and recitations. Smith's "Quantitative Chemical Analysis" is used as a text. [Course IV.]

Quantitative Analysis — C–30. Preparation: C–25. The fundamental principles acquired in Course C–25 are applied in this course in the examination of materials used in the textile mill, the dyehouse, and the finishing plant. Among the materials analyzed are water, soaps, oils, textile fabrics, stripping agents, acids and alkalies. The latest and most practical methods are employed. Griffin's "Methods of Technical Analysis" is used as a text. [Course IV.]

Industrial Chemistry (Lecture) — C–31. Preparation: C–23, C–24. During the whole of the third year lectures and recitations are held in industrial chemistry, the course in general following Rogers's "Manual of Industrial Chemistry." Particular attention is paid to those subjects which are of special interest to the textile chemist, as oils, soaps, gas and coal-tar industry, building materials, and the manufacture on a large scale of important chemical compounds, such as the common acids and alkalies, bleaching powders, various mordants, etc. The course is illustrated as far as possible with specimens, diagrams and charts, and the students are given an opportunity to visit some of the industrial establishments in the vicinity of Lowell and Boston. [Course IV.]

Advanced Textile Chemistry and Dyeing — C–32. Preparation: C–21, C–22. This is a continuation of the Textile Chemistry and Dyeing course of the second year, and includes a review of the second year's work in this subject, with the introduction of many advanced considerations, and, in addition, the following subjects: —

Classification and Construction of Artificial Dyestuffs. — A study from a more advanced standpoint of the classification and constitution of artificial dyestuffs including the various methods used in their production, also the orientation of the various groups which are characteristic of these compounds and their effect on the tinctorial power of dyestuffs.

The object of this study is to give the student a more complete knowledge of the artificial dyestuffs from the color manufacturer's point of view, which will

prove of particular value to those who intend later to enter the employ of dyestuff manufacturers or dealers.

Color Matching and Color Combining. — A study of that portion of physics which deals with color and the many color phenomena of interest to the textile colorist. The lecture work is supplemented with the practical application of the spectroscope and tintometer, and much practice in the matching of dyed samples of textile material.

The primary colors both of the scientist and textile colorist, the results of combining coloring lights and pigments, and such subjects as color perception, color contrast, purity of color, luminosity, hue, color blindness, dichroism, fluorescence and the effect of different kinds upon dyed fabrics, are discussed under this heading.

Each student's eyes are tested for color blindness early in the course, in order that he may be given an opportunity to change his course if his eyes should prove defective enough to interfere with his work as a textile colorist.

A dark room has been provided where various experiments in color work and color matching may be performed.

Dye Testing. — This subject includes the testing of several dyestuffs of each class, subjecting them to the common, color-destroying agencies; the determining of their characteristic properties, and their action towards the different fibers; also the determining of the actual money value and coloring power of dyestuffs in terms of a known standard.

Each student is required to make a record of each color tested upon an especially prepared card, which furnishes a permanent record of all dyestuffs, their dyeing properties, fastness to light and weather, washing, soaping, fulling, perspiration, bleaching, steaming, ironing, rubbing, acids and alkalies.

Union Dyeing. — A study of the principles involved in the dyeing of cotton and wool, cotton and silk, and silk and wool union materials in the production of solid and two-color effects.

Textile Printing. — A thorough study of the whole subject of textile printing, each student being required to produce individually no less than twenty different prints, including the following styles; pigment style, direct printing style, steam style with tannin mordant, steam style with metallic mordant, madder or dyed style, the ingrain or developed azo style, discharge dye style, discharge mordanted style, resist style, indigo printing, aniline black printing.

The different parts of the calico printing machine are thoroughly studied; also the precautions which must be considered in its use, and the arrangement of the dyeing apparatus which must accompany such a machine.

Special attention is paid to the methods of mixing and preparing the various color printing pastes that are used in the above work upon a manufacturing scale as well as experimentally in the laboratory.

Cotton Finishing. — A study of the various processes of finishing cotton cloth and the different materials used therein. The work involves the discussion of the various objects of cotton finishing and such operations as pasting, damping, calendering, stretching, stiffening, mercerizing, beetling and filling, and the various machines used for carrying out these processes.

Mill Visits. — During the third and fourth years visits are made to some of the large dyehouses, bleacheries and print works in the vicinity. [Course IV.]

Physical Chemistry — C-33. Preparation: B-20A, B-22, C-23, C-24. Two hours of lectures and recitations per week are given during the second term of the third year and throughout the fourth year. This subject includes a study of the fundamental laws and theories of chemistry, and the application of physical measurements to chemistry with illustrative problems. Special attention is given to textile applications. [Course IV.]

Advanced Organic Chemistry — C-34. Preparation: C-24. This is a continuation of Advanced Organic Chemistry C-24. [Course IV.]

Technical German — C-35. Preparation: E-21, C-21, C-23, C-24. This course consists of the reading of German technical literature, with the object of familiarizing the student with the current German publications in textile chemistry and coloring. [Course IV.]

Organic Chemistry Laboratory — C-36. Preparation: C-21, C-23, C-24, C-25. This course, while including practice in the usual methods of organic analysis,

and giving excellent training in the principles and manipulations of general organic synthesis, is especially devoted to the synthetic dyestuffs. The student not only prepares many of the representative dyestuffs, but, what is far more important, he carries out all the operations, beginning with coal tar itself. Thus, instead of merely coupling two or more of the foreign imported intermediate products to make a dyestuff, he starts with the basic substances obtained from the coal tar and makes his own intermediate products. As far as is possible the student will be made acquainted with the problems which might arise in a dyestuff factory, and an excellent opportunity is presented for original work. [Course IV.]

Technical German — C–40. Preparation: C–35. This is a continuation of Technical German C–35. [Course IV.]

Organic Chemistry Laboratory — C–41. Preparation: C–34. This is a continuation of Organic Chemistry Laboratory C–34. [Course IV.]

Engineering Chemistry — C–42. Preparation: C–23, C–24, C–25. A series of lectures is given upon the general subject of Engineering Chemistry, which includes particularly the consideration of fuels, oils and water from the chemical engineer's standpoint. The elements of chemical engineering are also considered to such an extent as time will permit. [Course IV.]

Engineering Chemistry Laboratory — C–43. Preparation: C–25. The lectures in Engineering Chemistry are very adequately supplemented by work in the Engineering Chemistry Laboratory, which is thoroughly equipped with the latest and best apparatus for the testing of fuels, flue gases, and lubricating materials. [Course IV.]

Physical Chemistry — C–44. Preparation: C–33. This is a continuation of Physical Chemistry C–33. [Course IV.]

Advanced Textile Chemistry and Dyeing — C–45. Preparation: C–32. This is a continuation of the third-year work in Advanced Textile Chemistry and Dyeing, and includes the following subjects: —

Advanced Organic Chemistry (Dyestuffs). Advanced study of the coal-tar coloring matters, their chemistry, relations of their composition to their coloring power, and the chemistry of their preparation.

Economics of the Dyeing, Bleaching and Finishing Industries. — A study of the factors to be considered in the establishment of a dyeing, bleaching and finishing plant together with the most essential considerations of its management.

Advanced Dyeing Conference. — During the latter part of his course each student will be required to write, for presentation before the other members of his class, a paper upon some assigned subject of general interest. After presentation the subject will be open to discussion and question.

The object of this conference is twofold. First, to give the student experience and practice in systematically looking up an assigned subject and presenting it before others; and secondly, to bring before the class a greater variety of subjects with more detail than could be covered by the general lectures of the course.

The Chemistry of Rayon, its Manufacture, Bleaching, Dyeing and Finishing. — During the past five years the developments of the bleaching, dyeing and finishing of rayon have been systematically studied and the curriculum of the Chemistry and Dyeing course has been revised from time to time to cover the latest developments in regard to these fibers. There is being installed at the present time a complete unit for the actual manufacture of different types of rayon, and with this available for experimental and demonstration purposes, it is anticipated that during the coming year instruction upon the production and subsequent treatment of rayon will be greatly amplified.

Many of the difficulties which arose during the early days of the artificial silk industry were due to lack of knowledge of its properties and more or less persistent attempts to handle it in just the same manner as real silk. As soon as the textile manufacturer began to fully appreciate the fact that the various rayons were entirely different fibers from true silk and consequently must be handled by different methods, then many extensive improvements were made in the processes of manufacturing textiles containing these fibers. In order to satisfactorily handle the different rayons they must receive a preliminary treatment with various oils

and softeners, and as a result the problem of establishing the specifications for the best type of oil to use for this purpose and also the best methods of removing it from the material during the finishing process have been important problems in the development of the industry, and these among others are being studied in the Lowell Textile Institute at the present time. [Course IV.]

Photography — C–46. Preparation: B–22, C–21, C–23, C–24, C–25. Photography is today indispensable to the scientist and textile chemist. Without the aid of photography he cannot preserve and keep an absolute and accurate record of his investigations and research problems.

The Institute therefore offers to the Senior Chemists an eight-week course in the elements of Photography. One object of this course is to provide the student with the preliminary knowledge and training necessary for the course in Microscopy and Photomicrography which follows.

The course includes a study of the different types of cameras and lenses, the making of contact prints from classified negatives using various grades of papers, reduction and intensification of negatives, enlarging, copying, negative making and lantern slide preparation.

The theory and chemistry of the above subjects are not only covered in the classroom but in addition all of this work is actually carried on by each individual student in the Photographic Laboratory and Dark Room.

Microscopy and Photomicroscopy — C–47. Preparation: B–22, C–21, C–23, C–24, C–25, C–46. The value of the microscope in the identification of textile materials and the examination of textile yarns and fabrics cannot be overestimated. In conjunction with photomicroscopy a permanent record which may be filed for future reference and which is understandable by non-technical men is obtained.

In this course, the students are given instruction in the use and construction of various types of microscopes and accessories; the preparation and mounting of samples; the identification of starches and fibers; microchemical reactions; and examination of fabrics for faults. Actual unknown fibers, starches and fabrics are examined and reported upon.

Following microscopy, the student takes up photomicroscopy, for which he has been prepared by a thorough course in the common processes of photography. The types and constructions of photomicrographic apparatus, adjustments, and exposures are taught by actual work in the photomicrographic laboratory. The student studies the use of such auxiliaries as color filters, polarized light, dark-ground illumination, color photography, and works at both high and low magnifications. At the end of the course the student is given a typical industrial or research problem on which he works independently and upon which he must prepare a complete report, illustrated by appropriate photomicrographs.

Quantitative Analysis — C–48. Preparation: C–30. This course consists of lectures, recitations and quizzes on the fundamental principles of analytical chemistry. [Course IV.]

Report Writing — C–49. The purpose of this course is, in general, to enable the student to write a technical report clearly and forcibly, and specifically to assist the student in preparing a well-written thesis.

An analysis of a complete formal report is first made. This is followed by a bibliography and instructions in the use of reference books and technical magazines. The methods of obtaining data, control of variables, and the use of graphs is taught by actual practice on laboratory results. The desirability of good mechanical form is emphasized, and a short review of punctuation is included.

Throughout the course the student is required to submit many reports, formal and informal, technical and non-technical, oral and written.

Frequent reports on the progress of the student's thesis are required so that he obtains practice in the correct presentation of the original data which he has obtained and the course is completed by the preparation of a formal thesis. [Course IV.]

Thesis — C–50. Before graduation the student must present a thesis which shall consist of a report of some original investigation or research that he has conducted while at the school.

A relatively large number of hours are specially set aside for this work, and students are encouraged to select some object for their investigation which shall be of practical as well as theoretical interest. [Course IV.]

TEXTILE DESIGN AND WEAVING DEPARTMENT — D

Textile Design and Cloth Analysis — D–10. During the first year instruction is given in the subject of classification of fabrics, use of point or design paper, plain fabrics, intersection, twills and their derivation, sateen, basket and rib weaves, checks and stripes, fancy weaves, including figured and colored effects; producing chain and draw from design, and *vice versa;* extending and extracting weaves.

This subject takes up in a systematic manner the analysis of samples illustrating the various cloth constructions for the purpose of determining the design of the weave and the amount and kind of yarns used, and forms the basis of calculation in the cost of reproducing any style of goods. The various topics discussed are reeds and setts; relation and determination of counts of cotton, woolen, worsted, silk and yarns made from the great variety of vegetable fibers; grading of yarns, folded, ply, novelty and fancy yarns; application of the metric system to yarn calculation; problems involving take-up, average counts, determination of counts of yarn, and weight of yarn required to produce a given fabric. [First term, all courses.] [Second term, Courses I, II, III, VI.]

Textile Design and Cloth Analysis — D–20. For Cotton Goods — Preparation: D–10. During the second year consideration is given to fancy and reverse twills, diaper work, damasks, skip weaves, sateen fabrics with plain ground, backed fabrics, and multiple ply fabrics. Students are required to make original designs and put the same into the loom. Special attention is given to the consideration of color effect.

During the first term free-hand drawing is taught by means of plates, and practice in coloring is given in conjunction with this work.

Practice in lettering, spacing and general arrangement of designs and sketches is given. The engineering alphabet is used in all work.

During the second term instruction is given in drawing, sketching, coloring and designing, with reference to their application in textiles. Good examples of applied design in textiles, as well as in other branches, are used as a basis for modified designs selected and composed by the student. This stimulates originality as well as teaches the student to appreciate good designs and color.

The analysis of these fabrics forms a part of the course in design. This also includes the necessary calculations required to reproduce the fabric or to construct fabrics of similar character. [Courses I, III, VI.]

Textile Design and Cloth Analysis — D–21. For Woolen and Worsted Goods — Preparation: D–10. During the second year the instruction given includes warp and filling backed cloth, figured effects produced by extra warp and filling, double cloths, multiple ply fabrics, cotton warps, blankets, bathrobes, crêpes, filling reversible, Bedford cords, imitation furs, crépons, matelasse and imitations, double plain, ingrains, velvets, corduroys, overcoatings, trouserings.

The analysis of these fabrics, together with the consideration of the shrinkages and dead loss in all fabrics, theory of diameter of yarns, and costs of blends and mixes is a part of this course. [Courses II, III, VI.]

Textile Design and Cloth Construction — D–30. Preparation: D–20 or D–21. The advanced work takes up the more complicated weaves adapted to harness work, and leads into leno and Jacquard designs. The following is a brief list of the subject heads, which will give some idea of the course: double plain cloths, ingrains, tricots, chinchilla, tapestry, blankets, upholsteries, spot weaves, pile or plush, crépon, matelasse and its imitations, piqué, Marseilles, quilting, and miscellaneous designs for Jacquard, leno, fustian, tissue fabrics and lappets.

Original designs and sketches for particular grades of goods and the study of color effects form an important part of the third-year course. It should be understood that work in decorative art is carried on in conjunction with textile construction and weaving, particularly on the Jacquard loom. Designs of merit are carefully developed in detail and woven into cloth.

The work in cloth construction includes the application of the different weaves and their combinations in the productions of fancy designs, both modified and original; the calculation involved in the reproduction of standard fabrics changed to meet varying conditions of weight, stock, counts of yarn and value; and the discussion of the breaking strength of fabrics and relationship of the construction of the fabric to breaking strength.

Instruction in this subject, which is given by classroom work, is intended to bring together the principles considered under the subject of design, cloth construction, weaving and yarn making of previous years, and to show the bearing each has in the successful construction of a fabric. [Courses III, VI.]

Decorative Art for Special Students. This course is planned to give a student a working knowledge and appreciation of design. The first and second years are devoted to a general study of design, color, perspective, lettering and rendering. Drawings are made in the historic styles for all materials, — wood, gold, silver, copper, brass, leather, fabrics, wall papers and glass.

In the third year students should specialize and devote their attention to the material in which they expect to work.

Power Weaving — D–22. Preparation: D–10. In connection with the work in Textile Design and Cloth Analysis practical work is carried on upon the power looms. This includes the preparation of warps, beaming, dressing, sizing, drawing-in and making of chains, the cutting and lacing of cards, spooling and quilling and the machinery for the same. A study is made of warpers and sizing machines, both for cotton and woolen. Lectures are given to correspond with the progress of the student in the Power Weaving Laboratory covering the following subjects: loom adjustments, chain building, shuttle changing looms, dobby looms, single and double acting dobbies, handkerchief motions, leno weaving, center selvedge motion, filling changing looms, oscillating reeds, lappet motions, various shaker motions, towel and other pile cloth weaving, Jacquard looms, single and double lift leno Jacquards, Jacquards of special design, tying up Jacquard harness. [Courses I, II, III, VI.]

Power Weaving — D–31. Preparation: D–20, D–21, or D–22. Instruction is given in weaving on fancy woolen and worsted looms, single and double acting dobbies, leno weaving, various shaker motions, lapper loom weaving, double and single lift Jacquard looms, tying up Jacquard harness, leno Jacquard, harness and box chain building; warp preparation for woolen and worsted and cotton; formulas for making up different kinds of sizing. Lectures are given to correspond with the same. [Courses I, II, III, VI.]

LANGUAGE AND HISTORY DEPARTMENT — E

English — E–10. Preparation: Admission Requirements. A technically trained man should be able to express himself clearly, forcibly and fluently, as inability to do so will be a serious handicap to him in after life. The object of the English course is to develop the student's power of expression by a thorough study of the principles of advanced rhetoric and composition, and by constant writing of themes illustrative of the four forms of discourse, viz., description, narration, exposition and argumentation. In addition to the study of rhetoric and composition and the writing of themes, several classics such as are not read in the preparatory schools are studied and discussed. [All courses.]

Elementary German — E–11. Preparation: Admission Requirements. This course is intended for first-year students who do not offer German as an entrance requirement and who desire to take the course in Chemistry and Textile Coloring. It may be selected by students taking the Textile Engineering course who have not fully met the entrance requirements in language. The work is elementary in character, and much time is devoted to the study of the rudiments of German grammar with practice in composition. During the latter part of the year considerable attention is given to the reading of ordinary German prose, which serves as an additional preparation to the student for the later reading of works along scientific and industrial lines. [Course IV.]

Advanced German — E–21. Preparation: E–11. For students taking the course in Chemistry and Textile Coloring the elementary course of the first year

is continued throughout the second year. The work consists of the study of some of the more advanced principles of grammar, and especially of the reading of scientific German, dealing with a variety of subjects, and the translation of commercial German. [Course IV.]

Economics — E-30. Preparation: E-10. This course, meeting three times a week, is conducted by means of lectures, discussions, and recitations, supplemented by textbook reading and study of charts analyzing various phases of industrial problems. The character of the course is descriptive and practical rather than theoretical, and the aim is to acquaint the student with the accepted principles of economics and some of their applications to industrial conditions.

The course will also deal briefly with economic history, showing how the present economic system has evolved from past systems and pointing out how the experience of the past can aid in the solution of present problems.

Besides the historical material, other topics discussed are the nature and scope of economics; the evolution of economic society; the three factors of production, land, labor and capital; the four elements in distribution, rent, wages, interest and profits; business organization; value and price; monopoly; money, credit and banking; international trade; protection and free trade; transportation; insurance; economic activities of municipalities; and public finance. In short, it is an outline course dealing with the fundamental principles that underlie a wide range of activities. [Courses I, II, IV, VI, first term.] [Courses IV, VI, second term.]

COTTON DEPARTMENT — F

Cotton Technology of Fibers — F-10. This course, given during the second term of the first year, takes up in considerable detail the culture and production of commercial cottons. The various commercial varieties and their characteristics are considered in detail. The classifying of cottons by grade and staple are thoroughly considered and during the last part of the course considerable time is given to the study of the intricate marketing system by means of which raw cotton is distributed. This course is given to those students who will continue the study of cotton yarn manufacture. [Courses I, III and VI.]

Cotton Technology of Fibers — F-10a. This general course of lectures, given during the second term of the first year, covers in a broad way the manufacture of cotton into yarns. The instruction covers the classification, grading and stapling of cotton, a study of the mechanical operations in yarn manufacture, a consideration of the product and waste of each of the operations, and the uses for which various yarns are suited. [Courses II, IV.]

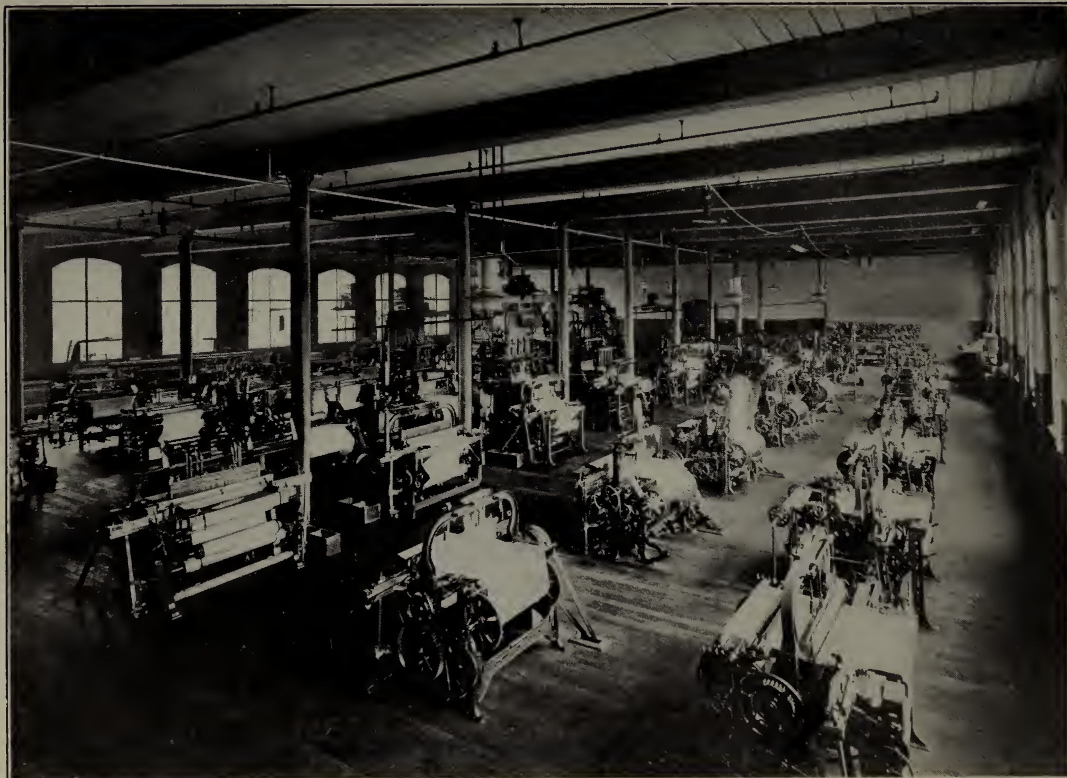
Cotton Carding — F-20. Preparation: B-10, B-12, B-14, F-10. Instruction is given by means of lecture and laboratory work. The outline of the course is as follows: —

Opening and Picking. — Instruction in the preliminary operation of opening and picking covers the mechanical construction of the machines, their parts and adjustments, as fully as the manufacturing results accomplished by the machines. This includes such construction details as evener, lap measuring and safety stop motion, grids, cleaning trunks, beaters, etc.; also operation details which involve the adjustment of waste, drafts and character of laps.

Carding. — The process of carding is considered one of the most important, and proper time is devoted to the construction and operation of cards, that the student may be familiar with the various parts of the card and the function and design of each. The construction and application of card clothing, as well as the methods of grinding, form a part of the work.

Combing. — This process is explained by lecture work and by operation and assembling of the various types of combs in service in the laboratory. The object of combing is fully considered, and the different means employed on the many types of combers on the market is studied. This includes such types as the Heilman, New Whitin and Nasmith combers.

Drawing. — Under this head is taken up the theory of doublings and their effect upon the quality of roving and yarn. Like previous and subsequent processes the machine construction forms an important part of the work. Proper stress is



Weave Room

paid to such subjects as stop motions, drawing rolls and their covering, cleaners and evener motions.

Roving Processes. — Under this head are studied the various machines known as the slubber, intermediate, fine and jack fly frames. The relative motion of the various parts of these machines is so complex that a good opportunity is here presented to fix in the student's mind the application of certain mechanical principles that are used in other departments and upon other machines in the manufacture of textile material. With each process of yarn manufacture are explained the systems of sizing and numbering, and under this head are taken up both the metric and English systems. [Course I.]

Cotton Carding — F–20a. Preparation: B–10, B–12, B–14, F–10. This course is similar to Course F–20, except that there is much less time devoted to lecture and laboratory work. [Courses III, VI.]

Cotton Spinning — F–30. Preparation: F–20. Ring Spinning and Twisting. — The consideration of spinning yarn by the ring frame method involves a knowledge of the uses to which the yarn is to be put, subsequent methods of handling that proper roving may be selected, suitable amounts of draft and twist provided, correct size of rings and travelers selected, building motions suitably adjusted, etc. The operation of twisting yarns is so closely related to spinning by the ring method that it is studied at the same time. This opens an almost limitless field of novelty yarn manufacture, and offers a very good opportunity to derive new types of yarn or new mechanism to produce the effects. Yarn defects are studied with reference to the cause and remedy.

Mule Spinning. — This method of spinning is very different from that of the ring frame, and the mechanical details are more complicated. The student is furnished with new means of producing yarns and can compare the relative advantage of each method. A thorough understanding of mule spinning is perhaps more a study of mechanical motions and their functions. This results almost invariably in assisting the student to understand previous processes and machines better because of his work on the mule. It is the object to make clear to the student's mind the principles underlying the construction and operation of the parts that control the drawing, twisting, backing off, winding, together with such special motions and devices as are used upon the modern mule.

Spooling. — This subject involves a study of the various types of spoolers, spooler speeds, tensions and production.

Winding. — The different makes of winders, the packages they make, the peculiarities, special features and production of each are discussed in this work.

Reeling. — Under this topic is included the construction of the machine, the types of winding possible, the quantity of yarn in a skein, and the packing of skeins into bundles. [Course I.]

Cotton Spinning — F–30a. Preparation: F–20a. This course is similar to Course F–30 except that there is much less time devoted to laboratory work. [Courses III, VI.]

Knitting — F–31. Preparation: B–12, D–10. This course, commencing with a study of hosiery yarns and their preparation for knitting, includes a study of the various stitches and their application in commercial fabrics; a study of the different knitting machines, including circular and flat, spring and latch needle machines, used in the manufacture of stockings, sweaters and underwear; and a study of looping and sewing machines. Part of the work consists of the assembling and adjusting of different types of knitting machines.

In addition, considerable time is spent in the analysis of knitted fabrics. [Courses I, II.]

Knitting — F–31a. Preparation: B–12, D–10. This course embraces the same lectures as Course F–31 but does not include any laboratory work. [Course VI.]

Cotton Organization — F–32. Preparation: F–20 or F–20a. This course correlates all the work in the Department of Cotton Yarns. The student is instructed how cotton yarn mill organizations are made, by the study of actual mill organizations, showing the drafts, doublings and sizes in use. This is followed by the calculation of machinery necessary to equip a given plant and the arrangement

of this machinery in the mill building. Some time is given to the study of special equipment not specifically covered in other classes. [Courses I, VI.]

Cotton Research Laboratory — F-33. Preparation: F-20. This is a short course in which the student studies the method of approach to various cotton mill problems. It acquaints him with the usual apparatus for a study of the physical defects in yarns and fabrics, using a variety of the more common ones as illustrations. [Courses I, VI C.O.]

Thesis — F-34. Each student is required to present a thesis which is a report of some original work. This is sometimes the construction of some yarn or fabric to meet certain requirements. At other times the work is a study of some technical problem regarding the effect of certain changes in manufacturing conditions. [Course I.]

WOOL DEPARTMENT — G

Technology of Fibers — G-10. The principles of converting loose fibrous materials into continuous twisted strands called yarn are discussed, and the nature and uses of spindle-drawn and roller-drawn yarns explained. Particular attention is given to the nature and processing of wool, allied fibers and reworked fibers. The source of supply, original and clean cost, and the effect of tariff and exchange on fibers and processed materials from foreign countries, are illustrated by examples. [All courses.]

Top Manufacture — G-20. Preparation: B-10, B-12, B-13. Raw Materials. — A study of raw materials which enter into the manufacture of woolen or worsted yarns, or are made into yarns by processes similar to those employed in the manufacture of woolen and worsted yarns, would include silk, mohair, alpaca, vicuna, cashmere, camel's hair, cotton, flax, hemp, jute and ramie. In connection with these are considered shoddy, noils, mungo and extracts.

Wool Sorting. — Familiarity with the various grades and kinds of wool is obtained by lecture and by actual sorting of fleece wool under the direction of an experienced wool sorter. The various characteristics and properties are explained, as are also trade terms, such as picklock, XXX, XX, ½-blood, ⅜-blood, ¼-blood, delaine, braid, etc. Some skill is acquired in the estimation of shrinkage and in judging the spinning qualities.

Wool Scouring. — The object of scouring and the methods employed are explained, and this involves the consideration of the soaps and chemicals used in washing; also the waste products and their utilization. Actual work is done in scouring a commercial quantity of wool by machines that are made similar in operation to regular commercial machines. A study is made of the effect of the hardness of water upon soap; also tests are made to show this effect. At the same time the use of dryers, their operation and regulation, is taken up, and the methods of carbonizing wool, noils, burr waste, rags, etc., are studied and practised.

Burr Picking, Mixing and Oiling. — In these processes preliminary to carding, the students have an opportunity of mixing various colors of wools to produce different effects and the influence of varying percentages of a given color in a mixture can be seen. Each student is required to make at least twenty sample mixes combining different colors and grades of stock, and to felt and mount the same. Under the subject of oils and emulsions are taken up the characteristics of various oils and the means employed to test these. The use of mixing and burr pickers is made clear.

Carding. — The different systems of carding wool, depending upon whether it is to be made into woolen or worsted yarn, are fully explained, as is also the construction, setting and operation of the cards. A part of the work is the reclothing and grinding of the cylinders, strippers, workers, etc. The carding of suitable and commercial quantities of wool, and the further manufacture of it into yarn, serves to fix the principles of carding in the mind of the student, as well as to give him some skill in handling machinery. At the completion of this part of the work he is required to prepare and hand in a full description of the process of carding, including working drawings, sketches, etc., to fully explain the machines and the methods.

Woolen Mule. — The student studies thoroughly the operation of the mule as a whole, and acquaints himself with the various principal mechanisms, as, for

example, the backing off and winding motions, the quadrant, builder-rail, faller regulation, etc.

Top Making and Combing. — This branch takes up, besides the carding of the wool on a worsted card, the preparing processes, back-washing and Vigoureaux printing, also gilling of the stock before and after combing. The construction of the gill boxes and combs is studied by lectures and by dismantling and assembling these machines in the laboratories. Later, quantities of stock are made into top and then into yarn.

The Noble comb is studied, and the various calculations to determine draft, noiling, tear, productions, etc., are made. [Courses II, III, VI.]

Yarn Manufacture — G–30. Preparation: G–20. Intersecting Gill Boxes and French Comb. — The equipment of the laboratory offers opportunity for the production of dry-combed top and its comparison with oil-combed top produced on the Noble comb. The structures and uses of intersecting gill boxes and the study of combing and drawing blends is taken up at this point.

Drawing and Spinning. — The laboratory equipment consisting of the Bradford (English) system of drawing, of both open and cone types, as well as the various processes of French drawing, followed by both worsted mule and ring spinning frame, make possible a thorough study of the manufacture of worsted yarn by all of the existing methods.

The same method of study of mechanisms, calculations, and operations of the various machines is followed as in the case of previous methods of instruction. The student by pursuing this course can compare the different methods of yarn manufacture and note the results of each.

Organization. — At the end of the course the layout of a properly balanced yarn mill is studied, and at the same time the cost of machinery, depreciation, labor costs and machinery arrangements.

Thesis. — Before graduation the student must present visible evidence of his knowledge of woolen and worsted manufacture by the production of twenty yards of fabric from his own design (or reproduction or modification of some existing fabric) beginning with the raw material.

A formal typewritten description, including all calculations and observations, together with samples from each machine, must be presented to the head of the department before the final examination. [Courses II, III, VI.]

Textile Testing — G–31. Preparation: B–22, F–30 or G–30, D–22. The object of this course is to familiarize the student with present-day methods of determining the physical properties of textile fibers, yarns and fabrics. The application of physical laws and methods of measurements, as studied in the course of Physics, is used in the study of physical characteristics of textile material. The work is given to students in advanced courses, and consists of lecture and laboratory work. Reports are prepared from each experiment, giving the object of the experiment, method of procedure, observation and conclusions, in order that the student may acquire practice and understand the interpretation of data. A special testing laboratory is provided, and a considerable number of the best standard fiber, yarn and fabric testing instruments of foreign and American make have been installed and are used for instruction in the testing of textile materials. The laboratory is equipped with means for making and keeping the humidity constant, so that tests can be made under uniform or standard conditions of humidity and temperature. [All courses.]

FINISHING DEPARTMENT — H

Woolen and Worsted Finishing — H–30. Preparation: B–12, C–10, D–10, D–22. The outline of this course, which is given by means of lecture and laboratory work, is as follows: —

Burling and Mending. — Under this head is taken up for consideration the examination of flannel as it comes from the loom; the construction, use and location of the perch; the methods used in marking defects, measuring, weighing and numbering of cloths; also the methods of inspection for fancies, single cloths and double cloths. The object of burling, mending and the types of tables employed, the method of removing knots, runners, etc., the object of back shearing and the use of burling irons, the replacing of missing threads and the importance of sewing

as a part of the finishing process, are all considered in detail. The removal of oil and tar spots as well as stains of various kinds is studied.

Fulling. — This branch covers a study of the conditions of the flannel as it comes from the loom, and the influence of oil, etc., upon the procedure. Considerable time is devoted to the various methods of producing a felt, the early types of stocks, hammer falling and crank stocks, and their modifications and development into the present type of rotary fulling mills of both the single and double variety. The details of construction in all machines are carefully taken up and include the design and composition of the main rolls, methods of covering, regulation and means of adjusting the pressure of traps and rolls, consideration of the shoes, the use and regulation of the various types of stop motion, the different types of stretchers, guide rolls and throat plates.

The theory of felt is taken up and the influence of pressure, moisture, heat, alkali and acid is considered, as well as the hydroscopic and felting properties of different wool fibers. The preparation of the flannel for the mill and the usual methods of determining shrinkages, as well as the various methods of soaping, are given careful attention. The preparation of various fulling soaps and the value of each for the production of various degrees of felt as well as the determination of the proper amount of alkali for various goods, are carefully studied and demonstrated. The manipulation of the various kinds of goods in the mill, viz., all wool, shoddies and mixed goods, is studied in classroom and by operation in the mill.

The change in weight and strength for each operation is carefully considered, as is also the value of the flocks made in each. A study of the various methods of flocking, such as dry and wet, is considered in both class and machine rooms. In each operation the defects likely to materialize are studied, as well as the cause thereof, and various methods of modifying or lessening them.

Washing and Speck Dyeing. — This branch considers the scouring, rinsing and washing of goods both before and after the fulling process; the various types of washers; and the details of construction, such as suds box, rolls, etc. The theory of scouring, uses of Fuller's earth, salt solutions and scours on the different kinds of goods are made clear by practical work in the machine room, where the effects due to improper scouring, such as stains, cloudy effects, wrinkles and unclean goods, are demonstrated. The discussion of the necessity of speck dyeing follows naturally from the study of these matters, and includes methods of preparation, materials used, application and tests required.

Carbonizing. — This is an important branch of finishing, and includes a study of the various carbonizing agents, methods of application, strength of solutions, and neutralizing, as well as the machines used. Stains and imperfections resulting from carbonizing are also considered. The drying and tentering machines and extractors employed are taken up at this point.

Gigging, Napping, Steaming, Singeing and Crabbing. — The construction in detail of the various types of gigs, nappers, steamers, wet gigs, rolling, stretching, crabbing, and singeing machines is discussed, and their actions upon the cloth and the results obtained are explained.

Various methods of obtaining luster and the production of permanent finish are considered in connection with steaming and sponging.

Brushing, Shearing and Pressing. — This includes, as do the other branches, a careful treatment of the machine employed, the preparation of the cloth for each process, the action of each machine in producing its part of the resultant effect. In manipulation of the shear consideration is given to its setting, grinding and adjustment. With the brushing machine the effect of steaming and moisture upon the luster and feel of the goods is shown. A study of the action of the presses, both plate and rotary, involves consideration of pressure, steaming, etc. Special processes to obtain particular effects are taken up, and the part played by each machine is explained. The details involved in handling cloth on a commercial scale, as, for example, measuring, weighing, ticketing, numbering and rolling, are also explained. The necessary calculation and the methods of finishing all grades of goods are considered from time to time during the year. [Courses II, III, IV, VI.]

Cotton Finishing — H-31. Preparation: B-12, C-10, D-10, D-22. The outline of the course in the finishing of cotton fabrics is as follows: —

Cloth Room. — Instruction of the various goods and the object thereof; construction of the various types of inspecting and trimming machines.

Shearing. — The object. A consideration of the various types of shears for treating one or both sides at the same time; also the use of the usual cleaning devices, such as emery, sand and card rolls, beaters and brushes; grinding and the adjustment of the various parts.

The use of brushing and cleaning machines, rolling devices and calender attachments for gray goods.

Singeing. — Developing and object of singeing; the construction of singers of all types and for various purposes; the use of cooling tanks, steaming devices, rolling and brushing attachments.

Regulation of the flame for various goods, and adjustment of the parts; gas and air pressure, water-cooled rolls; the effect of moisture on the cost of singeing and use of dry cans in connection with singeing; electric singeing.

Washing. — Open width and string washers, their construction and operation: soaps, temperature, squeeze rolls; washing of various goods and the object thereof; stains.

Napping. — The object of napping and the usual method of treating goods; various types of nappers, single and double acting; felting nappers; construction, grinding and adjustments of various types.

Water Mangles. — Their objects and the construction of various types; various rolls, iron, husk, etc.; scutchers, their object and constructions.

Starch Mangles. — The object and construction of all types of starch mangles for pure starch and filled goods; various types of rolls, brass, rubber, wood; action of doctor blades, etc.; regulation and object of pressure.

Methods of starching and finishing all standard goods, also a consideration of the various substances used, such as starch, softener and fillers; the preparation of starch and various methods of application.

Dryers and Stretchers. — Both horizontal and vertical types of drying cans, tenter frames, clips, etc.; the swing motion and the finishes thus produced; object and construction of spraying machines, belt stretchers, short tenters, button breakers, etc.

Calenders. — The object and construction of all types, including the regulation of pressure and nips for the production of various finishes; various types of rolls and their uses, — steel, husk, cotton, paper, etc.; the use of hot and cold rolls; chasing, friction, embossing and Schreiner calenders, and the various finishes produced by each; production of watered effects; beetling machines and hydraulic mangles.

Making-up room, — yarding, inspecting; different types of folds; pressing, papering, marking. [Courses I, III, VI.]

PHYSICAL EDUCATION

All members of the freshman class are required to take a course in physical training conducted in the gymnasium under the direction of an instructor in physical education. Two periods per week for the entire first year are devoted to this work. At the beginning of the year a full record is made of the physical examinations carried on by the instructor and a reputable physician that proper and beneficial exercise may be prescribed.

The object is to give general instruction in the care and strengthening of the body, and to so guide the students that they may continue to give proper thought to their physical training that their mental development may have its greatest effect.

Proper gymnasium clothing is required and all students must take a shower bath following each exercise.

EQUIPMENT

The equipment of machinery, inventoried at $330,850.00, is most varied for textile educational purposes, and is being constantly augmented. The builders of the various machines installed keep in close touch with the Institute, adding to

the machines such improvements as are made from time to time, and each year some new machine will be added by a manufacturer who finds it to his advantage to be represented here. This operates to the mutual advantage of student and manufacturer.

Cotton Yarn Department. — The opening and picking section of this department contains a 50-saw Pratt gin used for experimental purposes. For classing work, there is a specially equipped section with north light, where Universal Standard Grades and Government Staple Standards are available.

The picking equipment consists of two Kitson pickers, one 40-inch two beater breaker lapper with an automatic feeder and one 40-inch finisher lapper with a Perham and Davis evener. There is an extra Kirschner patent carding beater to be used in this finisher picker.

The card section has three standard revolving flat top cards, one each from Saco-Lowell, Whitin, and Howard and Bullough shops. One of these is equipped with a Chapman electric neutralizer to prevent trouble from static electricity.

The combing section consists of a sliver lapper, one four-head ribbon lapper, one six-head ribbon lapper, one two-head comb, one six-head comb and one eight-head comb, all from the Whitin Machine Works. There is also one two-head Nasmith comb from John Hetherington and Sons of England.

The drawing frames are all of the single head type. There are two four-delivery drawing frames and one railway head from the Saco-Lowell Shops. One frame is equipped with both common and metallic drawing rolls, electric stop motions and Ermine top roll clearers. The other frame and the railway head both are equipped with metallic rolls and mechanical stop motions. Another frame of two deliveries is from the Howard and Bullough shops. It has electric stop motions and metallic drawing rolls.

The roving section has a complete equipment, slubber, intermediate, fine and jack frame from the Saco-Lowell Shops. In addition, there is an intermediate frame made by the Woonsocket Machine and Press Company, and a fine frame from Howard and Bullough. The last named serves to illustrate the common English construction and how it differs from the American construction as illustrated in the other roving machines.

The spinning equipment is quite varied both with respect to builders and with respect to types and sizes. The Saco-Lowell Shops have supplied five different frames varying from 36 to 216 spindles. They are suitable to spin counts from 3s to 80s. One is equipped with the LeBlan Roth long draft system, while another has a special five roll long draft system built in the Institute. A sixth Saco-Lowell frame was supplied by the Acme Machine Company equipped with Chapman ball bearing spindles. Four of these frames are equipped with individual motor drives, — one chain drive, one Texrope drive, one gear drive and one Washburn clutch drive. The Whitin Machine Works is represented by three frames on which counts from 3s to over 100s can be spun. One of these frames has an auxiliary equipment of SKF roller bearing spindles. The Howard and Bullough shops have one spinning frame suitable for counts from average to fine. This is equipped with an English type of builder which distinguishes it from the other frames. One Fales and Jenks frame is present, equipped on one side with the Casa Blanca long draft system. This machine is equipped with an individual alternating current motor with a chain drive. One spinning mule has been retained to illustrate this peculiar type of spinning. It is from Asa Lees Company of England and is suitable for counts above 30.

There is one short spooler from the Saco-Lowell Shops. There are two winders from the Foster Machine Company, one for single ends either on cones or tubes, the other for one, two, or three ends parallel wound, especially for preparation for twisting. There is also a one gang Universal No. 50 winder suitable for winding ordinary tubes or Franklin Process packages.

The twisters are suitable for all counts. There is one each from the Saco-Lowell, the Howard and Bullough, and the Fales and Jenks Shops. These are all equipped for either wet or dry twisting of average and fine counts. There are two twisters from the Draper Corporation. These are equipped for wet or dry twisting for coarse counts or heavy plies.

The department has a complete coiler waste system as made by the Saco-Lowell

Shops, consisting of a 40-inch single coiler side delivery breaker card; a 40-end derby doubler; a 40-inch four coiler finisher card; a combination slubber-intermediate and a waste spinning frame. This equipment is suitable to spin coarse numbers from cotton wastes to be used in such materials as coarse sheeting, osnaburgs, twine and mop yarns.

To prepare mill wastes for re-use there is one single cylinder roving waste opener and one thread extractor, both from the Saco-Lowell Shops.

With the exception of the opening-picking room the humidity in this department is controlled automatically by a system installed by the American Moistening Company. Seven high duty heads supply the necessary moisture and air circulation. An adjustable automatic control regulates the humidity to the desired per cent.

The experimental laboratory is equipped with a power driven skein tester for determining yarn strength and a Moscrop single thread tester for single end strength. There are twist counters for determining the amount of twist and the twist contraction. For fine work and for fiber study, there is an analytical balance and a Spencer microscope equipped with three objectives, three oculars, ocular micrometer, mechanical stage and Abbé condenser. In addition, there is a gas conditioning oven to use in determining moisture content and regain. A number of scales and balances, together with yarn reels, roving reels and measuring boards make up the equipment for routine mill sizing tests.

Knitting Section. — The winders for this section include a six-spindle Universal winder for cones and tubes and a Payne bobbin winder.

The machines in the following group are equipped with special attachments for producing high splicing, double soling and striped work. The hosiery machines include two Acme full automatic, one arranged for 160 needles and the other for 200 needles; also a Mayo Model C full automatic arranged for 220 needles. Scott & Williams have placed in this section four of their machines, Models B–5, K, HH and RI. There are three Banner machines, all full automatic, two of which are arranged for 220 needles each and one arranged for 160 needles. There is one Brinton full automatic arranged for 176 needles and one Branson hand machine arranged for 80 needles. For hosiery legs and tops there are five ribbers, made by the Wildman Company, with cylinders varying from 3½–5¼ and arranged for needles varying in number from 160–240; two Brinton ribbers, one arranged for 176 needles and the other 200 needles; one Brinton tie machine, 1¾-inch cylinder 100 needles and 49 needles; one Universal Ribber 3½-inch diameter, 160 needles.

The underwear machinery consists of one Crane spring needle machine, one Scott & Williams ribber, and one Wildman ribber.

Under the group of flat machines there are three Lamb machines, one arranged for knitting gloves and one arranged for knitting sweaters. In addition to these there is also a Grosser sweater machine, a Jacquard machine, and a link and link machine; a Dubied scarf machine; and a Raschel warp knitter.

For finishing work this section includes a Grosser 2-thread looper, one Hepworth looper, two Beattie loopers; five Union special sewing machines for overseaming, double stitch covering, seaming and welting and vest finishing; six Merrow sewing machines, including two shell stitch machines and three overseaming and crocheting machines; three Singer machines; three Wilcox & Gibbs sewing machines, including a flat lock machine.

The Philadelphia Metal Drying Form Company has installed a table of six forms including men's, women's and children's.

For instruction in the manufacture of braids the New England Butt Company has installed one 24-line Hercules braider, one 12-line braider, one tubular braider, and one soutache braider.

Wool Yarns Department. — For instruction in wool sorting and grading the room is provided and equipped with benches, baskets, etc., as well as standard samples of all grades of wool which may be used for comparison and examination.

The scouring and carbonizing equipment installed by C. G. Sargent's Sons Corporation consists of one cone duster for grease wool; four scouring bowls arranged in tandem with necessary feeds and modern carrying properties; one single apron dryer, with automatic feeder; one carbonizing screw acid tank and duster, with crush rolls. In this same department the North Chelmsford Machine Company

has supplied a rinse box; Schaum & Uhlinger, one hydro-extractor; C. S. Dodge, one shoddy picker and one bagging stand.

Woolen. — In the woolen section there has been installed by the Atlas Manufacturing Company a Parkhurst burr picker. The Davis & Furber Machine Company has installed a mixing picker equipped with improved mixing picker feed and Spencer oiler, both made by George S. Harwood & Son, Boston, Mass. There are three sets of woolen cards furnished by Davis & Furber Machine Company which are equipped with Bramwell feed furnished by George S. Harwood & Son. One of the sets has the first and second breaker cards coupled. All have apron condensers on the finishers. There is a sample mixing card furnished by the Torrance Manufacturing Company which offers an opportunity for carrying on experiments and mixing various kinds and colors of wool. There are two spinning mules, 120 spindles each, one furnished by the Davis & Furber Machine Company of North Andover and equipped with bobbin holders supplied by the American Bobbin Holder Company, West Medway, Mass., and the other furnished by Johnson & Bassett, Worcester, Mass. In addition to these two mules each company has supplied for the purpose of instruction a spinning mule head mounted on movable platform to facilitate class instruction. Besides these mules the Davis & Furber Machine Company has supplied a fancy yarn twister, 20 spindles; the Lindsay Hyde Company modern skein winder. For card grinding the B. S. Roy & Son Company of Worcester, Mass., has supplied one grinding frame and two traverse grinders; T. C. Entwistle Company, Lowell, Mass., one traverse grinder; W. H. Brown, Worcester, Mass., one complete set of carder's tools.

Worsted. — In the worsted section the Davis & Furber Machine Company has furnished one double-cylinder worsted card (4 licker-in) with Bramwell feed. On this card as well as one in the woolen section the Chapman Electric Neutralizer Company has supplied one of its patented electric neutralizers. This section also includes a double bowl, 5-cylinder back-washer, with gill box, Taylor-Wordsworth & Co., Leeds, Eng., equipped with blueing motion, oiling motion, and Layland patent pressure motion; a weigh gill box and creel and one doubling balling head gill box (with double screws) made by the Saco-Lowell Shops of Lowell, Mass.; a worsted comb with baller punch made by Crompton & Knowles, Worcester, Mass.; two finishing gill boxes, one known as a can gill box and the other a balling head gill box, both made by Hall & Stell, Keighley, Eng.

For the manufacture of yarns under the Bradford System of Drawing, Spinning and Twisting, the following machinery as made by Prince Smith & Son, Keighley, Eng., make up the equipment: one revolving creel for 12 balls, one 2-spindle drawing box, one 4-spindle first finisher, one 12-spindle dandy reducer, one 12-spindle cap spinner, one double head can gill box, one 2-spindle gill box, one 2-spindle flyer spinner, one 12-spindle ring spinner, one 12-spindle 2-fold cap twister, one 12-spindle 6-fold ring twister. In addition to this the Saco-Lowell Shops, Lowell, Mass., have installed the following machinery to carry on similar work: one 2-spindle drawing box, one 6-spindle second finisher, one 24-spindle dandy rover, one 6-spindle cone reducer, one 8-spindle cone rover, one 48-spindle cap spinner, 5-foot end, one 48-spindle cap spinner, 4-foot end, one 48-spindle Boy ring twister. For conditioning yarn C. G. Sargent's Sons Corporation has supplied one of its conditioning machines. The Universal Winding Company has installed one of its 6-gang winders, equipped for cones or straight tubes.

The humidity in the laboratory of the woolen yarns and of the English system of worsted yarns is maintained by the American Moistening Company's system through its automatic control. In this laboratory are installed six humidifiers and four Comins's High Duty heads, which are supplied from an electric-driven triplex power pump located in the power house. This same pumping equipment supplies the American Moistening Company's humidifiers operating in the Cotton Yarn Department.

For the manufacture of worsted yarns under the French System of Drawing and Spinning the machinery has been made by the Société Alsacienne de Constructions Mechaniques, Mulhouse, France, and the equipment consists of the following: Model P. L. B. comb with creel for 24 doublings, intersecting gill box (2 heads), gill box (2 heads), first drawing (2 heads), second drawing (2 heads),

Wool Combing

third drawing (2 heads), reducer (4 porcupines), slubber (8 porcupines), first intermediate (8 porcupines), second intermediate (8 porcupines), rover (8 porcupines), finisher (16 porcupines), self-acting worsted mule (150 spindles).

The Saco-Lowell Shops built and installed a ring spinning frame of 60 spindles for worsted yarns equipped with individual General Electric Company's motor and a Reeves Variable Speed Transmission.

Twelve turbo humidifier heads automatically controlled by a humidity regulator have been furnished by the G. M. Parks Company, Fitchburg, Mass. The compressed air for these heads is supplied by an Ingersoll-Rand 8 by 8 steam-driven air compressor.

For the purpose of determining the physical properties of fibers, yarns, and fabrics there has been installed a Textile Testing Laboratory where there are the necessary microscopes and micrometers, a skein-testing machine, and electric conditioning oven made by the Emerson Apparatus Company of Boston; single yarn and fabric strength-testing machines made by G. R. Smith & Company, Bradford, Eng.; a strength-testing machine, capacity 500 kilograms, for testing twines and fabrics; a fiber-testing machine for testing fibers and fine yarns with capacity, 1 gram to 1.5 kilograms; a yarn strength-testing machine with capacity 1,000 to 5,000 grams; and a yarn strength testing machine with capacity 5 to 30 kilograms, all of which have been made by Louis Schopper, Leipzig, Germany. Besides these we have a standard yarn and fabric testing machine as made by Henry L. Scott & Company of Providence, R. I., and a Mullen Tester. For the automatic control of temperature and humidity there has been installed by the American Moistening Company, of Boston, one of its automatic humidity and temperature regulators.

Design and Power Weaving Department. — In the fabric analysis section there has been provided chemical balances made by Voland & Sons and Christian Becker, necessary twist testers, microscopes, reels, etc., as well as a Torsion calculation balance made by the Torsion Balance Company of New York.

In the warp preparation department there has been installed by the Saco-Lowell Shops one of its spoolers, besides a warper and a slasher for preparing cotton warps; a beamer by T. C. Entwistle Company of Lowell, a 400-end improved Draper warper furnished by the Draper Corporation of Hopedale, Mass. The Whitin Machine Company, Whitinsville, Mass., has supplied a 180-spindle, long chain quiller, and the Johnson & Bassett Company, Worcester, Mass., a quiller of its make. The Universal Winder Company has supplied a winder for cop and bobbin winding and an 8-spindle doubler.

The woolen and worsted warp preparation department contains two 40-end Jack spoolers, two spool racks for 12 spools each, one pattern dry frame dresser, one pipe and cylinder dresser, one 60-inch reel, one 82-inch reel, and one double head beamer, all supplied by the Davis & Furber Machine Company of North Andover, Mass.

The Weaving Department contains four looms supplied by the Draper Corporation of Hopedale, Mass., which include a plain Northrup, an 8-harness corduroy, an improved Northrup, a Northrup with dobby. The Stafford Loom Company of Readville, Mass., has installed one plain, one cam, one dobby loom and one broad sheeting loom, all equipped with individual motors; the Whitin Machine Works, Whitinsville, Mass., a side cam twill, a plain print cloth loom, equipped with Kip-Armstrong electric warp stop motion; the Kilburn & Lincoln a plain loom; Lewiston Machine Company a 4-harness side cam and a bag loom; Crompton & Knowles Loom Works a jean loom and a plain loom with individual drive. Four of these looms are equipped with Abbott cleavers made by the Abbott Wire and Cast Steel Warp Cleaving Company, Lisbon Falls, Maine. The Hopedale Manufacturing Company of Milford, Mass., has recently installed one of its high speed looms with individual motor.

The fancy loom section includes a Stafford Ideal 16-harness automatic shuttle-changing loom, a Whitin 20-harness dobby loom, and the following furnished by the Crompton & Knowles Loom Works: Knowles gingham 4 by 1 boxes, Crompton gingham 4 by 1 boxes, one Crompton towel 2 by 1 boxes, two Terry towel and one huck towel looms, a 16-harness lappet loom, a 20-harness dobby 4 by 1 boxes, fancy leno loom, and a Crompton fancy cotton single cylinder 20-harness dobby.

The woolen and worsted section contains a Knowles 20-harness Gem, a Crompton 24-harness worsted 4 by 4 boxes, a Crompton 6 by 1 double cylinder 20-harness dobby, one heavy 20-harness 4 by 4 boxes, one 20-harness and one 25-harness blanket, seven intermediate woolen 25-harness 4 by 4 boxes and two 90-inch 25-harness heavy woolen looms.

The Jacquard loom section includes one Stafford silk loom, 1,200-hook, Halton head; one 400-hook, single-lift, Schaum & Uhlinger Jacquard, mounted for 4-bank, narrow fabric loom; one Felix Tonnar German plush loom, with 400-hook Crompton & Knowles Jacquard head; one Skinner Brussels carpet loom, three-quarters wide, equipped with 1,280-hook Jacquard head presented by the Bigelow-Hartford Carpet Company, Clinton, Mass. The Crompton & Knowles Loom Works has furnished one Knowles fancy loom, single-lift Jacquard; one Knowles fancy loom, double-lift Jacquard; one Knowles fancy loom, Jacquard tied up for leno, one Knowles ingrain carpet loom, 4 by 4 boxes, one Knowles loom, 4 by 4 boxes, 54-inch, with 600-hook, double-lift, double-cylinder McMurdo Jacquard head, tied up for damask napkin designs, one Crompton ingrain carpet loom, 4 by 4 boxes, one Crompton & Knowles 72-inch tapestry loom, with 2,600-hook Halton Jacquard head, one 840-hook, double-lift, single-cylinder Jacquard on Crompton & Knowles 4-bank ribbon loom, one 800-hook, double-lift Knowles Gem silk brocade Jacquard machine, 4 by 4 boxes.

The silk loom section includes one Stafford silk loom, 20 harness dobby, 2 by 1 box motion, sliding bar warp stop motion, filling feeler, extended beam stands motor drive; one Crompton & Knowles silk loom, roller bearings, 4 by 4 box motion, 20 harness head motion, individual motor drive.

For the purpose of card cutting there has been furnished one Jacquard fine index card-cutting machine by John Royle & Sons, Paterson, N. J.; one Jacquard French index card-cutting machine by the same concern, and one Jacquard French index card-cutting machine presented by the Bigelow-Hartford Carpet Company, Lowell, Mass.

Chemistry and Dyeing Department. — The Chemistry Laboratory consists of one to give instruction in General Chemistry and Qualitative Analysis and provides facilities to take 120 students. The Quantitative Laboratory takes care of some 50 students and contains the necessary drying closet, steam bath, electrolytic table, with ample facilities to provide distilled water through the use of a Barnstead Water Still. The Balance Room, which is adjacent to the laboratory, has eleven analytical balances made by such concerns as Christian Becker, Eimer & Amend, and H. L. Becker's Sons & Company. The Organic Laboratory has facilities to take care of approximately 25 students having the necessary equipment required in the preparation of basic organic compounds and instruments used in the manufacture of dyes such as autoclaves, electric and gas combustion furnaces.

For the purpose of carrying on photographic and microscopic experiments and analyses the laboratory has been provided with equipment which includes besides the Bausch & Lomb microscopes, a polariscope made by Franz Schmidt & Haensch, Berlin, Germany, a Gaestner spectroscope, a Bausch & Lomb Model G photo-micrographic apparatus equipped with D. D. S. microscope and all necessary apparatus, a Kodak projection printer. In the dark room there has been placed a piece of apparatus for determining the relative fading powers of various light sources. Besides the common gas and electric lamps there is installed a solar determinator, made by the Atlas Electric Company, Chicago, Ill., also a 400-watt Nela Trutint and color-matching unit made by Nela Specialties Division, Cleveland, Ohio.

The Chemical Museum has been provided with cases and representative dyestuffs all furnished by various dyestuff manufacturers of this country and abroad. This offers an unparalleled opportunity for students to study and experiment with almost all of the representative dyes which are used in the textile industry.

The Experimental Dyeing Laboratory is equipped with individual benches, small dyeing apparatus, reels, balances, apparatus for dye testing, such as frames for exposing dyed material to light, and a complete collection of dyestuff samples and sample cards. There are also fifty-six steam coil experimental dyeing baths, a drying chamber and ageing chamber, in addition to a Hurricane Dryer, Class D,

made by the Philadelphia Drying Machinery Company, Pennsylvania. Adjacent to the Experimental Dyeing Laboratory there has been provided a well-lighted room for the storage of a great variety of dyestuffs. Steel shelving has been arranged so that the samples are easy of access. All samples are catalogued in a card file, thus facilitating their use.

The Experimental Printing Laboratory is equipped with a calico printing machine, made by Mather & Platt, Manchester, Eng., an iron-jacketed steaming chamber from A. Edmeston & Son, Patricroft, Eng., and a set of steam-jacketed copper kettles.

The Fuel and Oil Analysis Laboratory contains the following equipment for the analysis of coals and fuels: a Mather bomb calorimeter, with complete outfit, an Emerson bomb calorimeter, with complete outfit, a Parr calorimeter, an Abbé refractometer, a Torsian viscosimeter, a Tagliabue viscosimeter, a Tagliabue cold test apparatus, a Pensky Martin oil tester, a New York State oil tester, a Sartorius specific gravity balance, two Becker analytical balances, gas muffle furnace, Kny-Scherer oil tester, a Graefe gas calorimeter, an Orsat gas analysis apparatus, laboratory tables, lockers, and hoods.

The Industrial Chemistry Laboratory contains the following: one filter press, Type E. T. Shriver & Company; a single-acting triplex plunger pump, Goulds Manufacturing Company; a vacuum drying apparatus, a surface condenser, a Packard vacuum pump, Norman Hubbard's Sons; a vacuum evaporator, Swenson system, American Foundry and Machine Company; a centrifugal, C. H. Chavant & Company; a double jar mill, F. I. Stokes & Company.

To give instruction in dyeing on a basis which is more comparable with commercial practice there is provided a laboratory which includes the following equipment: a small kier, fitted with E. D. Jefferson's circulating device, an electrolyzer for manufacturing bleaching solutions, the National Laundry Machine Company, Dayton, Ohio; a Permutit filter, the Permutit Company, New York City; a mercerizing machine, a raw stock dyeing machine, Klauder-Weldon Dyeing Machine Company, Yardley, Pa.; a yarn dyeing machine, Klauder-Weldon Dyeing Machine Company; a jig dyeing machine, the Textile-Finishing Machine Company, Providence, R. I.; a set of drying cans by the same concern; a chain dyeing machine, T. C. Entwistle Company, Lowell, Mass.; a raw stock drying table, Proctor & Schwartz, Philadelphia, Pa.; a padding mangle, Arlington Machine Works, Arlington, Mass.; a hydro-extractor, W. H. Tolhurst & Son, Troy, N. Y.; a Psarski experimental dyeing machine, a Hussong experimental dyeing machine, equipped for raw stock or yarns, a Rodney Hunt sample piece dyeing machine, equipped with an automatic temperature and pressure-regulating apparatus, made by C. J. Tagliabue Manufacturing Company, Brooklyn, N. Y. The Franklin Process Company, Providence, R. I., have furnished a 25-pound bronze dyeing machine. Of the various dye tubs, one is equipped with a Monel Metal lining to withstand the action of various chemicals and dyes.

Finishing Department. — The Woolen and Worsted section includes a 4-string washer, a fulling mill, and a combination fulling and washing mill for jersey fabrics, furnished by the Rodney Hunt Company, Orange, Mass.; a sample fulling mill, a kicker mill, furnished by James Hunter & Company, North Adams, Mass.; an up and down dry gig, a rolling and stretching machine, an up and down wet gig, a steam finishing machine, a 60-inch, 3-burner singeing machine, adapted for cotton, silk or worsted goods, a 2-cylinder double-acting brushing machine, a 60-inch, 4-cylinder sanding and polishing machine, furnished by Curtis & Marble Machine Company, Worcester, Mass.; a mantle steaming and air cooling machine, donated by Curtis & Marble Machine Company, and equipped with a direct connected motor and a Nash pump; a 66½-inch motor driven, single woolen shear, equipped with list saving motion, donated by Curtis & Marble Machine Company; a 6/4 double shear, an A. W. C. measuring and weighing machine, furnished by Parks & Woolson, Springfield, Vt.; a dewing machine, a 6/4 Voelker rotary press, furnished by G. W. Voelker & Co., Woonsocket, R. I.; a tentering and drying machine furnished by John Heathcote, Providence, R. I., a single crabbing machine, H. W. Butterworth & Son, Philadelphia, Pa.; a 72-inch woolen napper donated by Davis & Furber, North Andover, Mass.; a 32-inch basket hydro-extractor, W. H. Tol-

hurst, Troy, N. Y.; a Lintz & Eckhardt cloth numbering machine, from Durbrow & Hearne Company, New York; a steam press for underwear, United States Hoffman Company, Syracuse, N. Y.; a sewing machine, Birch Brothers, Somerville, Mass.; a trimming and overseaming machine, The Merrow Machine Company, Hartford, Conn.

The Cotton section includes a 40-inch inspecting and brushing machine, a 44-inch No. 25 railway sewing and rolling machine, a 44-inch cotton shearing machine, Type No. 34, a 44-inch No. 3 steam calender rolling machine, a 40-inch cloth folder, a 40-inch winder and measurer, a set of 44-inch shear blades for grinding purposes, furnished by Curtis & Marble Machine Company, Worcester, Mass.; a 48-inch No. 4 opening, sewing and rolling machine, a No. 1 hand power portable railway sewing machine, furnished by Dinsmore Manufacturing Company, Salem, Mass.; a 40-inch 4-tank open soaping machine equipped with patent flushing rolls, brass and rubber squeeze rolls and spiral openers, furnished by Birch Brothers, Somerville, Mass.; an 84-inch 36-roll, ball bearing, double acting napper, equipped with a 7½-horsepower General Electric motor drive, furnished by Davis & Furber, North Andover, Mass. (the ball bearings were donated by the Fafnir Bearing Company, New Britain, Conn.); an 8-inch belt lacer furnished by the Clipper Belt Lacer Company of Grand Rapids, Mich.; a 40-inch, 3-roll water mangle, with husk and brass rolls and usual attachments and equipped with a 48-inch Mycock scutcher, and a 40-inch Mycock cloth expander made by Thomas Leyland & Company, Boston; a 40-inch, 2-roll starch mangle, a 40-inch upright drying machine with 10 copper cylinders equipped with Files dry can system, Files Engineering Company, Inc., Bridgeport, Conn.; a 40-inch sprinkler, a 40-inch, 5-roll Universal calender with chasing attachment and equipped with a 40-inch Mycock cloth expander, a pasting table with plate, furnished by the Textile-Finishing Machinery Company, Providence, R. I.; a 16 by 24 inch bronze-covered stretcher for the drying cans, C. A. Luther & Company, Providence, R. I.; a 40-inch double bristle stretcher for drying cans, American Finishing Machinery Company, Boston, Mass.; a trimming and overseaming machine, The Merrow Machine Company, Hartford, Conn.; a 40-inch Tommy Dodd starch mangle, and a 44-inch, 50-foot vibratory tentering machine, H. W. Butterworth & Sons Company, Philadelphia, Pa. This machine is directly driven by a 7½-horsepower variable speed motor and is equipped with a Schwartz automatic electric guider, made by L. H. A. Schwartz & Company, Boston, Mass.

Engineering Department. — The Steam Engineering Laboratory contains the following equipment arranged for experimental purposes: A 50-horsepower Allis-Chalmers Corliss steam engine direct connected to an Alden absorption dynamometer, and piped to exhaust its steam to the atmosphere, to a Wheeler surface condenser or to the Kerr turbine; a Kerr seven-stage turbine driving directly a 25-kilowatt Richmond Electric Company's alternating current generator and piped to exhaust either to the atmosphere or the condenser. It may be operated either as high pressure or low pressure turbine, and the generator has special connections to illustrate various commercial phases. In addition there are a 4 by 6 Deane triplex power pump, two 2-inch centrifugal pumps made by Lawrence Machine Company, Lawrence, Mass., a Clayton air compressor and necessary tanks, scales and measuring instruments. For the measurement of flow of air there are a steam-driven Sturtevant fan and a motor-driven Massachusetts fan with heater combined for heating and drying experiments.

The Electrical Engineering Laboratory consists of two sections, one of which is devoted to instruction in the generation and transmission of power, and contains the necessary switchboard and instruments to control a 25-kilowatt alternating current turbo generator and a 15-kilowatt motor generator set arranged to supply either direct or alternating current. In addition there are a 24-horsepower direct current Allis-Chalmers motor and a 10-horsepower direct current General Electric motor, also a 10 and a 7.5 horsepower General Electric alternating current motor besides a General Electric 3-kilowatt rotary transformer and three Westinghouse stationary transformers. The other section of the laboratory is known as the instrument laboratory and is for the purpose of giving instruction in the measurement of current voltage, resistance, and in the calibration of instruments. It con-

tains a 5-kilowatt Crocker-Wheeler balancer, a 160-ampere hour storage battery, a 5-kilowatt 220-volt to 440-volt General Electric transformer, a Westinghouse portable wattmeter with current and potential transformers, three wattmeters, two ammeters and a voltmeter, all of the General Electric portable alternating current type, a 30-volt alternating current Roller Smith voltmeter, a 5 to 10-scale Weston ammeter (electro-dynamometer type), a Weston millivoltmeter with 2, 20, 50 and 200 ampere shunts, three 250-volt direct current Weston voltmeters, a 150-ampere, two model, 45 two model 260 Weston portable ammeters, a Weston model 260 voltmeter, a Thompson 50-ampere recording wattmeter, a General Electric rotating standard wattmeter, two General Electric induction type watt. hour meters, an Esterline portable curve drawing wattmeter, a 100-ampere Leeds & Northrup Standard Resistance, a Leeds & Northrup Ayrton shunt, a Weston laboratory standard voltmeter with 600-volt multiplier, a Leeds & Northrup potentiometer, a D'Arsonval wall type galvanometer, a Wheatstone bridge with galvanometer, a slide wire bridge and electro-dynamometer, Weston Standard cell, potential phase shifter, a standard Leeds & Northrup photometer with Lummer-Brodhun screen, and Macbeth illuminometer made by the same concern.

Machine Shop. — The equipment of the machine shop is as follows: Four standard engine lathes, 13-inch swing, 6-foot bed, from Flather & Company, Nashua, N. H.; three standard engine lathes, 14-inch swing, 6-foot bed, from Flather & Company, Nashua, N. H.; a standard engine lathe, 15-inch swing, 6-foot bed, from F. E. Reed Company, Worcester, Mass.; an engine lathe, 18-inch swing, 10-foot bed, from Flather & Company, Nashua, N. H.; an engine lathe, 18-inch swing, 6-foot bed, from Champion Tool Works, Cincinnati, Ohio; a standard engine lathe, 15-inch swing, 6-foot bed, from S. H. Putnam Sons, Fitchburg, Mass.; five speed lathes, 17-inch swing, 5-foot bed, from J. G. Blount, Everett, Mass.; one No. 1 Universal milling machine, with all three feeds automatic, from Kempsmith Manufacturing Company, Milwaukee, Wis.; one 24 by 24 inch, 6-foot planer, from the Mark Flather Planer Company, Nashua, N. H.; one 23-inch upright drill, with back gears and power feed, from J. E. Snyder & Son, Worcester, Mass.; one 14-inch single sensitive drill, from the Stanley Manufacturing Company, Lawrence, Mass.; one No. 1 Universal grinder, from Landis Tool Company, Waynesboro, Pa.; one 20-inch wet tool grinder, from J. G. Blount, Everett, Mass.; one 12-inch, 2-wheel dry grinder, from J. G. Blount, Everett, Mass.; an American twist drill grinder, from the Heald Machine Company, Worcester, Mass.; one Type 1B portable electric grinder from the Cincinnati Electric Tool Company, Cincinnati, Ohio; one 30-inch grindstone and frame, from the Athol Machine Company, Athol, Mass.; a single spindle centering machine, from D. E. Whiton Machine Company, New London, Conn.; one 15-inch shaper, from Potter & Johnson, Pawtucket, R. I.; one power hacksaw, from the Fairbanks Company, Boston, Mass.; one cold saw, from John T. Burr & Son, Brooklyn, N. Y.; one Eureka metal power saw, Manning, Maxwell & Moore; one Type CC electric drill, Cincinnati Electric Tool Company; one Universal milling attachment for Kempsmith milling machine, Taylor Machinery Company; one Hisey Type B ½-horsepower tool post grinder, Taylor Machinery Company; one No. 2 Cory bench straightener, Manning, Maxwell & Moore; one No. 3 Universal cutter and reamer grinding machine, Browne & Sharpe; a well-equipped tool room containing a selected stock of the best makes of small tools, such as drills, taps and dies, milling cutters, reamers, gauges, micrometers, etc.

Power, Light, Heat and Ventilating Plant. — In the powerhouse there is located the main power-generating apparatus for supplying light, heat and power to all departments of the Institute. The equipment here consists of: two 250-horsepower Heine water tube boilers, equipped with Perfection grates, a 300-horsepower Aultman & Taylor horizontal water tube boiler, equipped with United States rocking grates, two boiler feed pumps — one a Knowles and the other a Deane — a 40,000-pound Cochrane metering open-feed heater, which is provided with a Lea recorder, and a Cochrane oil extractor heats and measures all feed water, a 3-inch Venturi meter in feed line with indicating manometer as made by the Builders Iron Foundry, Providence, R. I. In the Engine Room are located: a Payne 14 by 14 automatic high speed engine, 125-horsepower direct connected

to 75-kilowatt, 220-volt, direct-current Bullock generator, a 9½ by 11 Nash gas engine of 50-horsepower, 4-cycle type, with speed-regulating clutch and a "hit and miss" governor, direct connected to a 30-kilowatt, 220-volt, direct-current Bullock generator, a 65-kilowatt motor generator set, consisting of a direct current motor and an alternating current generator. This unit may be run either A. C. to D. C. or D. C. to A. C., and was made by the Westinghouse Electric and Manufacturing Company. A steam-driven Ingersoll-Rand 8 by 8 air compressor, for use with Turbo heads, installed in the French Spinning Department by the G. M. Parks Company, Fitchburg, Mass., a 5½ to 6 motor-driven air compressor, with 20 cubic foot storage tank for use in starting Nash gas engine, a Cross oil filter. The station switchboard is of marine-finished slate, 90 inches in height, and consists of three generator panels and two circuit panels.

The powerhouse is connected with the main school buildings by a tunnel through which all wires, steam and water pipes are carried. The steam pipes supply heat to the buildings by means of direct radiation, and by means of the Sturtevant double duct heating and ventilating system located in the basement of Southwick Hall, and by the Sturtevant fan and heater located in the basement of Kitson Hall. Direct-driven exhaust fans are placed on the roof of Southwick Hall and in the basement laboratories.

GRADUATES WITH TITLES OF THESES

June 4, 1929

Bachelor of Textile Chemistry

Alvin Wilfred Bergeron, Haverhill, Mass. "Effect of pH in the degumming bath on strength and luster of a celanese-silk union."

Charles Joseph Fredrickson, Jr., Andover, Mass. "Effect of additional substances in the mercerizing bath."

Amos Kempton Haynes, Haverhill, Mass. "Use of kieropon in resist printing under vat colors."

Patrick Joseph Hetherman, Lowell, Mass. "Removal of mineral oils used as wool lubricants."

Ralph Wentworth Holbrook, Allston, Mass. "Study and comparison of various sulphonated oils."

Ira Swain Hurd, Haverhill, Mass. "Relative heat insulating values of various fibers and fabrics."

Walter Coburn Lindsly, Lowell, Mass. "Effect of tension on mercerization of cotton yarn."

Bernard Michael Phelan, Ipswich, Mass. "Quantitative chemical analysis of mixed fiber fabrics."

Bertil August Ryberg, Centerville, Mass. "Study of the synthesis of the Naphthol AS series through the acid chlorides."

John Prince Stanley, Jr., Lewiston, Me. "Study of textile crayons."

Clayton Collington Westbrooke, North Andover, Mass. "Investigation of tippy dyeing on raw wool with top chrome colors."

Raymond Edward Wiech, Lowell, Mass. "Chemical evaluation of oxycellulose."

Bachelor of Textile Engineering

Ralph Herman Balch, Billerica, Mass. "A determination of the relation between yarn strength and fabric strength." (Thesis with Laurence C. Holt.)

Harry Saville Buzzell, Lowell, Mass. "A study of the finishes of cotton fabrics by optical measurements." (Thesis with James O. Ellis.)

James Oliver Ellis, Chelmsford, Mass. Thesis with Harry S. Buzzell.

Laurence Currier Holt, Lexington, Mass. Thesis with Ralph H. Balch.

Norman McKinnon, Lowell, Mass. "A determination of the effect of blending carded and combed stock upon the properties of the resulting yarns."

Robert Jackson Matthews, Gardner, Mass. "The design and construction of a stroboscope and a study of its application to textile processes."

Walter Flemings Myers, Lowell, Mass. 1. "The construction of a mechanical device for measuring the diameter of yarns and a study of its properties." 2. "An investigation of the possibility of using oscillatory circuits for measuring the density of yarns."

Kenneth Earl Rice, Stoneham, Mass. "A study of the tension in cotton yarns during spinning and the development of an autographic device for recording the same."

Charles Leopold Shelton, Boston, Mass. "A comparison of yarns produced by long draft methods with yarns of standard manufacture." (Thesis with Benjamin J. Zalkind.)

Benjamin Joseph Zalkind, Dorchester, Mass. Thesis with Charles L. Shelton.

Diploma Graduates

Cotton Manufacture

Borden Dickinson Billings, Auburndale, Mass. "The manufacture of a cotton whipcord."

John Girvin Cluett, Troy, N. Y. "The processing and testing of tanguis, a Peruvian cotton, to determine its possibility for a commercial yarn without blending."

ARNOLD GEORGE STEPHENS, Roslindale, Mass. "The effect of twist on the strength and elasticity of a 30's cotton yarn."

Wool Manufacture

PAUL RICHARD EVANS, Stoneham, Mass. "The manufacture of a woolen suiting."
WALTER URBAN GAUDET, Lowell, Mass. "The manufacture of a woolen suiting."

Textile Design

HERBERT BARON GREENBAUM, Roxbury, Mass. "The manufacture of a Melton fabric."

Prizes awarded in June, 1929

Textile Colorist Award of $100 offered to a member of the graduating class whose thesis, based upon his personal researches and experiences, is of the greatest practical value to the dyeing, bleaching, or textile finishing industries. To *Bertil August Ryberg* and *Clayton Collington Westbrooke.*

The Medal of the National Association of Cotton Manufacturers awarded to the student taking course in Cotton who maintains the highest average in scholarship throughout this course. To *Benjamin Joseph Zalkind.*

Louis A. Olney Prizes (in the form of books).

$20 to the regular student in the Chemistry and Textile Coloring course who shall present the best thesis preparatory to graduation. To *Walter Coburn Lindsly.*

$10 to the regular student of the Chemistry and Textile Coloring course who shall be considered as having attained the highest scholarship during his second year. To *Eric Arthur Peterson.*

$5 to the regular student of the Chemistry and Textile Coloring course who shall be considered as having attained the second highest scholarship during his second year. To *Norman Albin Johnson.* Honorable Mention, *Gerald Anthony Ivers.*

$10 to the student taking the regular Chemistry and Textile Coloring course who shall be considered as having attained the highest scholarship in first-year Chemistry. To *Joseph James Pizzuto, Jr.*

$5 to the student taking the regular Chemistry and Textile Coloring course who shall be considered as having attained the second highest scholarship in first-year Chemistry. To *Leo Gleklen.* Honorable Mention, *Herbert Eugene Meinelt.*

A $15 prize for meritorious work in the department of Chemistry and Textile Coloring. To *Earle Raymond McLean.*

Scholarships

The *Proprietors of the Locks and Canals* on the Merrimack River offered a scholarship which provides for tuition to a graduate from either of the degree courses at this Institute. The candidate must be recommended by the President and Trustees. The scholarship covers tuition for two years only to one who is seeking a master of science degree at the Massachusetts Institute of Technology. Awarded to *Bertil August Ryberg.*

The Textile Color Card Association Scholarship. — For the purpose of promoting interest in color harmony and color blendings for textile material, this association offered in June, 1929, a scholarship providing free tuition to a member of the class of 1931, the scholarship to continue for two years in accordance with specified conditions named in the offer. Awarded to *Margaret Gray Scadding.*

Herbert A. Currier Scholarship. — $100 given by Herbert A. Currier, of the Class of 1906, to a student selected by the faculty of the Institute, the following conditions to be considered in making the selection: scholastic standing, financial need, and ability in promoting student activities in school life. To *Edward Joseph Allard.*

REGISTER OF DAY STUDENTS

Candidates for Degree

Class of 1930

Name	*Home Address*	*Lowell Address*
Barsky, Morris Arnold, IV,	Dorchester, Mass.	113 School Street
Beeman, Earl Royal, VI,	Quincy, Mass.	9 White Street
Carbone, Alfred John, IV,	Haverhill, Mass.	———
Cleveland, Richard Sumner, VI,	East Pepperell, Mass.	———
Colby, Willard Alvah, Jr., IV,	Bradford, Mass.	Phi Psi House
Dunlap, Kirke Harold, Jr., VI,	Lowell, Mass.	58 Hanks Street
Gallagher, Arthur Francis, IV,	Lowell, Mass.	36 Merrill Street
Greendonner, George John, Jr., IV,	Stafford Springs, Conn.	142 Riverside Street
Gross, Herman Peter, IV,	Lowell, Mass.	Phi Psi House
Howorth, Harmon, VI,	Lowell, Mass.	Omicron Pi House
Jones, Bliss Morris, IV,	Lexington, Mass.	Omicron Pi House
Kolsky, Samuel Irving, IV,	Lawrence, Mass.	———
Konieczny, Henry, IV,	Dracut, Mass.	———
Kostopoulos, Emanuel Arthur, VI,	Lowell, Mass.	270 Adams Street
Krishan, Maharaj, VI,	Montgomery, India	125 Mount Washington Street
McDonald, Gerald Francis, IV,	Lowell, Mass.	208 Mount Hope Street
McGee, Francis Patrick, IV,	Lowell, Mass.	94 Beacon Street
McLean, Earle Raymond, IV,	Haverhill, Mass.	142 Riverside Street
Meady, Benjamin Balch, IV,	Lexington, Mass.	159 White Street
Preston, Harold Lawrence, VI,	Wakefield, Mass.	———
Ray, Lloyd Sanford, IV,	West Newbury, Mass.	3 Belmont Street
Robbins, Walter Archibald, VI,	Lowell, Mass.	102 South Loring Street
Stacey, Alfred Charles, IV,	Andover, Mass.	———
Stewart, John Weeden, IV,	Lowell, Mass.	Phi Psi House
Tamulonis, Edward William, VI,	Nashua, N. H.	272 Merrimack Street
Topjian, Leon, IV,	Lowell, Mass.	98 Fremont Street

Class of 1931

Allard, Edward Joseph, IV,	Lowell, Mass.	116 Ennell Street
Bagshaw, Herbert Arthur, VI,	Lowell, Mass.	92 Jenness Street
Bradford, William Swanton, VI,	Andover, Mass.	———
Burtt, Joseph Frederic, VI,	Lowell, Mass.	23 Grace Street
Casey, Francis Harold, IV,	Roslindale, Mass.	159 White Street
Danahy, Arthur Joseph, IV,	Lowell, Mass.	37 Clark Street
Duggan, Paul Curran, IV,	Lowell, Mass.	58 D Street
French, Wallace Howe, IV,	Lowell, Mass.	636 Rogers Street
Grant, Alfred Thomas, IV,	Haverhill, Mass.	524 Moody Street
Hale, Ralph Edgar, IV,	West Newbury, Mass.	18 Mount Vernon Street
Hall, Stanley Arundel, IV,	Haverhill, Mass.	Phi Psi House
Hardman, Joseph Edwin, IV,	Lowell, Mass.	51 Westchester Street
Hosmer, Frank Barbour, IV,	Lowell, Mass.	226 Gibson Street
Ivers, Gerald Anthony, IV,	East Chelmsford, Mass.	———
Jarek, Julius, IV,	Lowell, Mass.	74 Eleventh Street
Johnson, Norman Albin, IV,	Deep River, Conn.	Omicron Pi House
Lathrop, John Francis, IV,	Lowell, Mass.	37 Varney Street
Lifland, Abraham, IV,	Roxbury, Mass.	113 School Street
Loveless, Everton Hanscom, VI,	Melrose, Mass.	Omicron Pi House
Maher, Margaret Mary, IV,	Lowell, Mass.	44 Keene Street
McAllister, Gordon, IV,	North Billerica, Mass.	———
McDonald, John Joseph, IV,	Lowell, Mass.	208 Mount Hope Street
Orlauski, Anthony, IV,	Haverhill, Mass.	———
Parker, John George, Jr., IV,	Chelmsford, Mass.	———

Peterson, Eric Arthur, IV, Lowell, Mass.	14 Winthrop Avenue
Piligian, Hiag Nishan, IV, Springfield, Mass.	37 Varney Street
Quigley, Gerald Francis, IV, Lowell, Mass.	51 Crawford Street
Rawlinson, Richard William, VI, Lowell, Mass.	430 Pine Street
Russell, Harold William, VI, Sanford, Me.	78 Gates Street
Stewart, Alexander, VI, Andover, Mass.	———
Stifel, Edward William, Jr., IV, Wheeling, W. Va.	Omicron Pi House
Sung, Harvey Chih, VI, Tientsin, China	137 Riverside Street
Toher, Francis Luke, IV, Providence, R. I.	524 Moody Street
Wallace, Max Joseph, IV, Malden, Mass.	113 School Street

Class of 1932

Armitstead, Russell Arthur, IV, Lowell, Mass.	628 Wilder Street
Babigan, Edward, IV, Lowell, Mass.	121 Bellevue Street
Barry, Marie Gertrude, IV, Lowell, Mass.	31 Hoyt Avenue
Bertrand, Arthur Leon, IV, Lowell, Mass.	27 West 5th Street
Brosnan, James Henry, IV, Lowell, Mass.	100 White Street
Campbell, Allan, Jr., VI, South Boston, Mass.	37 Varney Street
Churchill, Charles Whittier, Jr., VI, Lowell, Mass.	214 Third Street
Clark, Gerald Burrill, VI., Lowell, Mass.	Phi Psi House
Cook, Vernon Stanley, VI, Lowell, Mass.	677 Westford Street
Dudley, Albert Richard, VI, Lowell, Mass.	126 Coburn Street
Ferguson, Thomas Dickson, Jr., VI, Little Falls, New York	Omicron Pi House
Gleklen, Leo, IV, Lynn, Mass.	113 School Street
Glowacki, Joseph, VI, Andover, Mass.	———
Greene, William Joseph, Jr., IV, Edgewood, R. I.	118 Mount Washington Street
Hegy, Gerard John, VI, Holyoke, Mass.	106 Crawford Street
Hockridge, Stanley Squire, IV, North Adams, Mass.	Omicron Pi House
Howard, Lorne Fernley, IV, North Chelmsford, Mass.	———
Kiernan, John James, VI, Lowell, Mass.	22 Phillips Street
King, Daniel Joseph, IV, Lowell, Mass.	158 Pleasant Street
Lifland, Bessie, IV, Roxbury, Mass.	Y. W. C. A.
McDougall, Francis Gerard, VI, Lowell, Mass.	637 Broadway
McQuaid, Barton Mathewman, IV, North Billerica, Mass.	———
Meehan, John Joseph, IV, Lowell, Mass.	35 Varney Street
Meinelt, Herbert Eugene, IV, Lawrence. Mass.	———
Moran, Edward Francis, IV, Lowell, Mass.	75 Beacon Street
O'Brien, Daniel Joseph, Jr., VI, Lowell, Mass.	90 Parkview Avenue
Pizzuto, Joseph James, Jr., IV, Pittsfield, Mass.	Phi Psi House
Savard, Aimé Albert, IV, Lowell, Mass.	311 Mammoth Road
Sawyer, Henry Severance, VI, Dalton, Mass.	———
Silva, George Preston, VI, Lowell, Mass.	75 Highland Avenue
Spalding, Arthur Ovila, IV, Lowell, Mass.	84 D Street
Spaulding, Ned, VI, Hudson, N. H.	———
Stearns, Kenneth Lawrence, IV, Lowell, Mass.	43 Grace Street
Walker, Samuel J., IV, East Liverpool, Ohio	37 Varney Street
Wang, Yun-Cheng, VI, Shanghai, China	53 Mount Hope Street
Wojas, Stanley Edward, IV, Lowell, Mass.	24 Ray Court

Class of 1933

Bachner, Simon, IV, Roxbury, Mass.	———
Birenbaum, William, IV, Haverhill, Mass.	———
Birtwell, John Lincoln, IV, East Chelmsford, Mass.	———
Burke, James Edward, IV, Lowell, Mass.	77 Durant Street

Custer, Herbert James, IV, Lowell, Mass.	4 Hildreth Street
Daley, Charles Lincoln, IV, Lowell, Mass.	239 Stevens Street
Dempsey, Phillip Edward, IV, Monson, Mass.	43 Plymouth Street
Donohoe, Edward Joseph, VI, Lowell, Mass.	49 Butterfield Street
Farrell, Milton Atherton, IV, Lowell, Mass.	68 Forest Street
Forsythe, George, VI, Andover, Mass.	———
Garner, John William, IV, Kezar Falls, Me.	98 Mount Vernon Street
Genest, Roland Napoleon, IV, Lowell, Mass.	75 Westford Street
Gifford, Alden Ives, Jr., VI, Lowell, Mass.	18 Marlborough Street
Glowienski, Mitchell, IV, Lowell, Mass.	198 West Sixth Street
Hallissy, John Joseph, VI, Manchester, Mass.	Phi Psi House
Harrington, Eleanor Marie, IV, Lowell, Mass.	1002 Central Street
Harris, Frederick Harry, VI, Lowell, Mass.	66 Princeton Street
Kokoska, Michael, VI, Lowell, Mass.	122 Lakeview Avenue
Lacaillade, Laurence Louis, IV, Methuen, Mass.	142 Riverside Street
Lawson, Russell Munroe, VI, Andover, Mass.	———
Lifland, Moses, VI, Roxbury, Mass.	———
Markarian, Haig, IV, Lowell, Mass.	103 Lawrence Street
Matthews, Raymond Lewis, IV, Gardner, Mass.	137 Riverside Street
Morse, Robert Turnbull, VI, Lowell, Mass.	466 Beacon Street
Moses, Nicholas, IV, Lowell, Mass.	83 Mount Vernon Street
Murphy, John Joseph, VI, Lowell, Mass.	124 Liberty Street
Raymond, Frank Everett, Jr., VI, Ipswich, Mass.	272 Merrimack Street
Recher, Theodore, VI, North Providence, R. I.	119 Mount Washington Street
Robillard, Gerald Adelbert, IV, Lowell, Mass.	124 Riverside Street
Schaltenbrand, Alfred Leo, IV, Framingham, Mass.	37 Varney Street
Shapiro, Simon, VI, Lowell, Mass.	84 Cambridge Street
Towle, Gerald Charles, VI, Lowell, Mass.	35 Juniper Street
Turcotte, David Henry, IV, Lowell, Mass.	523 Fletcher Street
Wells, Henry Alfred, Jr., IV, Elizabeth, N. J.	37 Varney Street
Whitcomb, Irving Joseph, VI, Andover, Mass.	———
Wilkie, Robert Campbell, VI, Newton Centre, Mass.	137 Riverside Street
Young, Edmund Joseph, Jr., IV, Lowell, Mass.	545 School Street

Diploma Students

Class of 1930

Carleton, Joseph Raddin, III, Haverhill, Mass.	Omicron Pi House
Garner, Allen Frank, II, Kezar Falls, Me.	98 Mount Vernon Street
Kilmartin, John Joseph, I, Lowell, Mass.	62 Highland Avenue
Peary, John Ervin, III, Wilton, Me.	———
Pero, Richard Omer, II, Lawrence, Mass.	Omicron Pi House
Sadler, Thomas Sheridan, II, Billerica, Mass.	———
Tang, Hsiung-Yuan, I, Wusih, China	53 Mount Hope Street

Class of 1931

Babb, Charles Wilkes, Jr., II, Camden, Me.	142 Riverside Street
Carpenter, Carleton Warner, II, Lowell, Mass.	14 Staples Street
Daley, Raymond Joseph, II, Lowell, Mass.	239 Stevens Street
Scadding, Margaret Gray, III, Lowell, Mass.	223 Parkview Avenue
Taft, David Russell, II, Oxford, Mass.	43 Plymouth Street
Truesdale, Elmer Vine, I, Lewiston, Me.	Phi Psi House
Verry, Richard Morton, III, Salem, Mass.	11 White Street
Williams, Albert William, III, Lowell, Mass.	178 First Street

Class of 1932

Atkinson, Alan Alexander, II, Lowell, Mass.	77 Wilder Street
Bucknam, Nathan Arthur, II, Dexter, Me.	100 Riverside Street

Cohen, Donald Berlove, II, Rochester, N. Y.	113 School Street
Crawford, John Thomas, II, Rockland, Mass.	43 Plymouth Street
Crosier, Walter Schuster, II, North Adams, Mass.	100 Riverside Street
Donahue, Edward Emerson, II, Norwood, Mass.	Phi Psi House
Ellis, Holbrook Belknap, II, Monson, Mass.	43 Plymouth Street
Farrenkopf, John Anthony, III, Somerville, Mass.	Phi Psi House
Golec, Edward Lucian, III, Lowell, Mass.	117 Coburn Street
Heath, Allen Watson, I, Charlotte, N. C.	272 Merrimack Street
Niles, Francis Bernard, III, Somerville, Mass.	Phi Psi House
Stursberg, Laird, II, New York, N. Y.	18 Astor Street
Yung, E-Zung, I, Shanghai, China	53 Mount Hope Street

Special Students

Bockes, Russell Henri, II, Skaneateles, N. Y.	142 Riverside Street
Brady, Anamay Smith, III, Lowell, Mass.	233 Westford Street
Gernay, Leon, III, Waereghem, Belgium	Phi Psi House
Kendrick, James B., II, Winchester, Mass.	———
Merchant, Edith Clara, Lowell, Mass.	268 Westford Street
Wilson, James French, II, Davis, Calif.	137 Riverside Street

ALPHABETICAL LIST OF GRADUATES

The following list has been corrected in accordance with information received previous to February 1, 1930. Any information regarding incorrect or missing addresses is earnestly solicited.

B.T.C. indicates the degree of Bachelor of Textile Chemistry; B.T.D. indicates the degree of Bachelor of Textile Dyeing; B.T.E. indicates the degree of Bachelor of Textile Engineering; D indicates a diploma; C indicates a certificate (covering a partial course only). Degrees were issued beginning with the year 1913.

Abbot, Edward Moseley, II, '04 (D). Vice-President, Abbot Worsted Company, Graniteville, Mass.

Abbott, George Richard, II, '08 (D). Andover, Mass.

Adams, Floyd Willington, VI, '16 (B.T.E.). Superintendent, The Barrett Company, Peoria, Ill.

Adams, Henry Shaw, I, '05 (D). Secretary and Treasurer, Eureka Cotton Mills and The Springstein Mills, Chester, S. C.

Adams, Tracy Addison, IV, '11 (D). General Manager, Arnold Print Works, North Adams, Mass.

Albrecht, Charles Henry, IV, '17 (B.T.C.). Chemist, The Bell Company, Worcester, Mass.

Almquist, George John Edwin, I, '19 (D). Second Vice-President, Passaic-Bergen Lumber Company, Ridgewood, N. J.

Anderson, Arthur Illman, IV, '24 (B.T.C.). Department of Research, Laundry Owners National Association, Joliet, Ill.

Anderson, Arthur Julius, IV, '19 (B.T.C.). Salesman, National Aniline and Chemical Company, 40 Rector Street, New York City.

Anderson, Clarence Alfred, VI, '25 (B.T.E.). Time Study Engineer, Manville-Jenckes Company, Pawtucket, R. I.

Anderson, Harold Robert, II, '26 (D). In charge of Research Laboratory, Abbot Worsted Company, Forge Village, Mass.

Annan, David, II, '23 (D). With Everlastik, Inc., 180 Spencer Avenue, Chelsea, Mass.

Arienti, Peter Joseph, IV, '10 (D). Chief Chemist and Dyer, Sayles Finishing Plants, Inc., Saylesville, R. I.

Arundale, Henry Barnes, II, '07 (D). In charge of Research Department, United States Testing Company, Inc., 1415 Park Avenue, Hoboken, N. J.

Atwood, Henry Jones, II, '23 (D). Assistant Superintendent, Daniels Manufacturing Company, East Brookfield, Mass.

Avery, Charles Henry, II, '06 (D). Died January, 1913.

Babigan, Raymond, IV, '24 (B.T.C.). Patent Examiner, United States Patent Office, Washington, D. C.

Bachelder, Charles Edward, IV, '24 (B.T.C.). Plant Chemist, Slatersville Finishing Company, Slatersville, R. I.

Bailey, Joseph W., I, '99 (D). Agent, Booth Manufacturing Company, New Bedford, Mass.

Bailey, Lester Harold, IV, '24 (B.T.C.). Textile Chemist, Tubize Artificial Silk Company, 2 Park Avenue, New York City.

Bailey, Walter James, IV, '11 (D). Bailey's Cleansers and Dyers, Watertown, Mass.

Baker, Franz Evron, VI, '26 (B.T.E.). Instructor, Cotton Yarn Department, Lowell Textile Institute, Lowell, Mass.

Baker, Maurice Sidney, IV, '25 (B.T.C.). Merchant, Fine's, Attleboro, Mass.

Baker, William John, IV, '16 (D). Supervisor, DuPont Rayon Company, Old Hickory, Tenn.

Baker, William Samuel, I, '26 (D). Assistant Systemizer, Nashua Manufacturing Company, Nashua, N. H.

Balch, Ralph Herman, VI, '29 (B.T.E.). Research Department, Pacific Mills, Lawrence, Mass.

Baldwin, Arthur Lincoln, IV, '00 (D). Died December 1, 1919.

Baldwin, Frederick Albert, II, '04 (D). Vice-President and Secretary, Walter Blue & Co., Ltd., Sherbrooke, Que.

Ballard, Horace W. C. S., IV, '08 (D). Died September 28, 1918.

Barlofsky, Archie, VI, '17 (B.T.E.). Merchant, Economy Cash Market, 165 Chelmsford Street, Lowell, Mass.

Barr, I. Walwin, I, '00 (D). Second Vice-President, Buckley Brothers Company, 881 Broadway, New York City.

Barrett, Andrew Edward, IV, '23 (B.T.C.). Field Engineer, Armour & Co. (Industrial Soap Division), Babbitt, N. Y.

Barry, Leo Joseph, II, '27 (D). With The Bell Company, Worcester, Mass.

Bauer, Harold Conrad, III, '28 (D). Assistant Designer, Merrimac Mills, Methuen, Mass.

Beck, Frederic Christian, II, '24 (D). In business, Weld & Beck, Southbridge, Mass.

Bell, Edward Benjamin, IV, '24 (B.T.C.). Owner, Bell's Food Shop, Lowell, Mass.

Bennett, Edward Howard, II, '03 (C). Publisher, American Wool and Cotton Reporter, 530 Atlantic Avenue, Boston, Mass.

Bennett, Herbert Bowen, II, '13 (D). Died January 23, 1920.

Bentley, Byron, II, '26 (D). With Joseph Bentley Hair Company, Methuen, Mass.

Bergeron, Alvin Wilfred, IV, '29 (B.T.C.). Textile Chemist, Celanese Corporation of America, Amcelle, Md.

Berry, Wilbur French, II, '17 (D). President and Treasurer, Wilbur Manufacturing Company, Providence, R. I.

Bienstock, George Jerrard, III, '24 (D). Buyer and Styler, The Bloch Company, Cleveland, Ohio.

Bigelow, Prescott Fenno, II, '12 (D). Died October 14, 1918.

Billings, Borden Dickinson, I, '29 (D). Woolen Designer, Thorndike Company, West Warren, Mass.

Bird, Clarence Henry, II, '22 (D). Superintendent, George E. Duffy Manufacturing Co., Worcester, Mass.

Bird, Francis John, VI, '22 (B.T.E.). 30 West Street, Attleboro, Mass.

Blaikie, Howard Mills, II, '11 (D). Salesman and Assistant Styler, American Woolen Company, 225 Fourth Avenue, New York City.

Blake, Parker Gould, VI, '14 (D). District Manager, Claude Denis & Co., Ltd., Toronto, Ont.

Blanchard, John Lawrence, II, '23 (D). Designer, Farnsworth Company, Lisbon Centre, Me.

Bloom, Wilfred Nathaniel, IV, '03 (D). Died August 17, 1918.

Bodwell, Henry Albert, II, '00 (D). With Ludlow Manufacturing Associates, 80 Federal Street, Boston, Mass.

Booth, James Mooney, IV, '24 (B.T.C.). Salesman, The Huron Milling Company, Inc., 9 Park Place, New York City.

Bottomley, John, III, '28 (D). Assistant Designer, Amoskeag Manufacturing Company, Manchester, N. H.

Boyd, George Andrew, I, '05 (D). Vice-President, Appleton Company, Lowell, Mass.

Boylston, Theodore Willmott, IV, '21 (B.T.C.). Died June 3, 1921.

Brackett, Martin Richard, II, '22 (D). With Mackay, Sigler & Taylor, 215 Fourth Avenue, New York City.

Bradford, Harold Palmer, II, '25 (D). 90 Beach Street, Malden, Mass.

Bradford, Roy Hosmer, II, '06 (D). Textile Machinery, 161 Devonshire Street, Boston, Mass.

Bradley, Raymond Frost, VI, '14 (D). Garage Proprietor, Twin Light Garage, 267 East Main Street, Gloucester, Mass.

Bradley, Richard Henry, V, '01 (C). Gasolene Salesman, Fairhaven, Mass.

Brainerd, Arthur Travena, IV, '09 (D). Manager, Chicago Office, Ciba Company, 233 West Huron Street, Chicago, Ill.

Brainerd, Carl Emil, IV, '20 (B.T.C.). Overseer of Dyeing, F. C. Huyck & Sons, Albany, N. Y.

Brainerd, Carroll Lewis, IV, '19 (B.T.C.). Died May 28, 1928.

Brandt, Carl Dewey, VI, '20 (B.T.E.). Head of Textile Department, Texas Technological College, Lubbock, Texas.

Brannen, Leon Vincent, III, '07 (C).

Brickett, Chauncy Jackson, II, '00 (D). Director, School of Textiles, International Correspondence School, Scranton, Pa.

Brickett, Raymond Calvin, II, '14 (D). Overseer, M. T. Stevens & Sons Company (Marland Mills), Andover, Mass.

Brigham, Howard Mason, VI, '24 (B.T.E.). Salesman, Wellington, Sears & Co., 65 Worth Street, New York City.

Bronson, Howard Seymour, II, '27 (D). Overseer of Knitting, Portage Hosiery Company, Portage, Wis.

Brosnan, William Francis, IV, '27 (B.T.C.). Superintendent, Antipyros Company, 551 West 52d Street, New York City.

Brown, Gerald Marston, VI, '22 (B.T.E.). With Cheney Brothers, South Manchester, Conn.

Brown, Phillip Franklin, II, '23 (D). District Sales Manager, DuPont Rayon Company, 2 Park Avenue, New York City.

Brown, Rollins Goldthwaite, IV, '12 (D). Sales Representative, White Brothers, Inc., Winchendon Springs, Mass.

Brown, Russell Lee, VI, '21 (B.T.E.). Assistant Professor, Lowell Textile Institute, Lowell, Mass.

Brown, Will George, Jr., IV, '22 (B.T.C.). Chemist, American Hide & Leather Company, Lowell, Mass.

Buchan, Donald Cameron, II, '01 (D). Assistant Superintendent, M. T. Stevens & Sons Company, North Andover, Mass.

Buchan, Norman Spaulding, IV, '26 (B.T.C.). Overseer of Dyeing, Pitman Manufacturing Company, Laconia, N. H.

Burbeck, Dorothy Maria, IV, '20 (B.T.C.). See Garlick, Mrs. Dorothy M.

Burger, Samuel Joseph, III, '24 (D). Buyer, Max Burger & Co., New York City.

Burnham, Frank Erwin, IV, '02 (D). Chemist, Pacific Mills, Worsted Division, Lawrence, Mass.

Burns, Robert, IV, '28 (B.T.C.). In charge of Experimental Dyeing Laboratory, with Celanese Corporation of America, Amcelle, Md.

Burrage, Katharine C., IIIb, '99 (C). Died May 16, 1914.

Buzzell, Harry Saville, VI, '29 (B.T.E.). Chemist, Oxford Paper Company, Rumford, Me.

Callahan, John Joseph, Jr., II, '26 (D). Color Chemist, A. Klipstein & Co., 263 Summer Street, Boston, Mass.

Cameron, Elliott Francis, IV, '11 (D). Attorney-at-law, 100 Milk Street, Boston, Mass.

Campbell, Alexander, VI, '23 (B.T.E.). Resident Engineer, Charles T. Main, Inc., Engineers, 201 Devonshire Street, Boston, Mass.

Campbell, Laura Etta, IIIb, '00 (C). Deceased.

Campbell, Louise Porter, IIIb, '03 (C). With Ginn & Co., 15 Ashburton Place, Boston, Mass.

Campbell, Orison Sargent, II, '03 (D). Manager Felt Department, Canadian Consolidated Felt Company, Ltd., Kitchener, Ont.

Cannell, Philip Stuart, VI, '23 (B.T.E.). Industrial Engineer, MacDonald Brothers, Inc., 6 Foster Street, Everett, Mass.

Carr, George Everett, I, '05 (D).

Carr, Paul Edward, II, '24 (D). Designer, Pondicherry Woolen Company, Bridgton, Me.

Carter, Robert Albion, IV, '02 (D). Dyestuff Salesman, E. I. du Pont de Nemours & Co., 1503 Hampden Boulevard, Reading, Pa.

Carter, Russell Albert, II, '25 (D). With Thermo Mills, Inc., West Sand Lake, N. Y.

Cary, Julian Clinton, VI, '10 (D). Branch Manager, American Mutual Liability Insurance Company, 226 Pearl Street, Hartford, Conn.

Caya, Ferdinand Joseph, IV, '22 (B.T.C.). Superintendent of Dyeing, Gotham Silk Hosiery Company, Inc., Wharton, N. J.

Chamberlin, Frederick Ellery, I, '03 (D). Overseer of Spinning, Monument Mills, Housatonic, Mass.

Chandler, Proctor, IV, '11 (D). Manager, Chandler Manufacturing Company, 56 Amherst Street, Cambridge, Mass.

Chang, Chi, VI, '23 (B.T.E.).

Chang, Wen Chuan, VI, '21 (B.T.E.). Dah Sung Cotton Mill No. 1, Nantung, Kiangsu, China.

Chapman, Leland Hildreth, VI, '24 (B.T.E.). Principal, Ashby High School, Ashby, Mass.

Chen, Shih Ching, IV, '22 (B.T.C.). Hou Sung Cotton Mill, Shanghai, China.

Chen, Wen-Pei, IV, '24 (B.T.C.).

Chisholm, Lester Bury, I, '11 (D). General Plant Manager, American Mills Company, Waterbury, Conn.

Church, Charles Royal, II, '06 (C).

Churchill, Charles Whittier, III, '06 (D). Manager, Churchill Manufacturing Company, Inc., Lowell, Mass.

Clapp, Frank Austin, II, '04 (D). General Agent, Northeastern Surety Company, Springfield, Mass.

Clark, Earl William, IV, '18 (B.T.C.). Research Chemist, Cheney Brothers, South Manchester, Conn.

Clark, Thomas Talbot, II, '10 (D). President and Treasurer, Talbot Mills, North Billerica, Mass.

Clarke, George Dean, II, '21 (C). Dyer, Seaman & Cobb Thread Mills, Hopkinton, Mass.

Clayton, Harold Edmund, VI, '21 (B.T.E.). Superintendent, Scottsboro Hosiery Mills, Scottsboro, Ala.

Cleary, Charles Joseph, II, '13 (D). Textile Technologist, United States Army Air Service, Wright Field, Dayton, Ohio.

Clement, David Scott, IV, '24 (B.T.C.). Chemist, Nashua Manufacturing Company, Nashua, N. H.

Clifford, Albert Chester, VI, '22 (B.T.E.). Textile Engineer, Western Electric Company, Inc., Kearny, N. J.

Clogston, Raymond B., IV, '04 (D). Superintendent of Dyeing, Merrimack Manufacturing Company, Lowell, Mass.

Cluett, John Girvin, I, '29 (D). Cloth Analyst, Cluett, Peabody & Co., Inc., 433 River Street, Troy, N. Y.

Coan, Charles Bisbee, IV, '12 (D).

Coffey, Daniel Joseph, III, '28 (D). Assistant Superintendent and Finisher, Thermo Mills, Inc., Hudson, N. Y.

Cohen, Arthur Edward, IV, '23 (B.T.C.).

Cohen, Raphael Edvab, IV, '25 (B.T.C.). Secretary and Sales Manager, Merrimack Paper Tube Company, Inc., Lowell, Mass.

Colby, James Tracy, VI, '16 (D). Salesman, F. C. Huyck & Sons, Albany, N. Y.

Cole, Edward Earle, IV, '06 (D). Financial Agent, The Bradstreet Company, Boston, Mass.

Cole, James Thomas, II, '05 (D). Treasurer, Arlington Industries for the Blind, Arlington, Mass.

Collonan, Herbert Joseph, II, '22 (D). Designer, Beoli Mills, Fitchburg, Mass.

Coman, James Groesbeck, I, '07 (D). Superintendent, Mexia Textile Mills, Mexia, Texas.

Conant, Harold Wright, I, '09 (D). Assistant Treasurer and Director, United Elastic Corporation, Easthampton, Mass.

Conant, Richard Goldsmith, I, '12 (D). Sales Executive, Wellington, Sears & Co., 65 Worth Street, New York City.

Conklin, Jennie Grace, IIIb, '05 (C). See Nostrand, Mrs. William L.

Connor, Thomas Francis, II, '28 (D). 41 Elmore Street, Roxbury, Mass.

Finishing Department

Connorton, John Joseph, Jr., III, '27 (D). Assistant Designer, Amoskeag Manufacturing Company, Manchester, N. H.

Cook, Kenneth Bartlett, I, '13 (D). General Manager, Southern Mills, Manville-Jenckes Company, Pawtucket, R. I.

Corbett, James Francis, IV, '28 (B.T.C.). Chemist, Pacific Mills, Lawrence, Mass.

Cosendai, Edwin Frederick Ernest, IV, '15 (B.T.D.). Died November 1, 1923.

Cote, Theodore Charles, IV, '26 (B.T.C.). Chemist, Merrimack Manufacturing Company, Lowell, Mass.

Craig, Albert Wood, IV, '07 (D). Superintendent, Windsor Print Works, North Adams, Mass.

Craig, Clarence Eugene, III, '02 (D).

Creese, Guy Talbot, IV, '14 (D). Chemist, Creese & Cook Company, Danversport, Mass.

Crowe, Joseph Bailey, IV, '25 (B.T.C.). Textile Chemist, Procter & Gamble Co., Cincinnati, Ohio.

Culver, Ralph Farnsworth, IV, '04 (D). Vice-President and Manager, Providence Office, Ciba Company, Inc., 61 Peck Street, Providence, R. I.

Cummings, Edward Stanton, VI, '16 (D). Industrial Engineer, with R. E. Loper & Co., Greenville, S. C.

Curran, Charles Ernest, III, '02 (C). Head Designer, Wood Worsted Mills, Lawrence, Mass.

Currier, Herbert Augustus, I, '06 (D). Cotton Yarns, Waterman, Currier & Co., Inc., 40 Worth Street, New York City.

Currier, John Alva, II, '01 (D). Superintendent, Pentucket Mills (M. T. Stevens & Sons Company), Haverhill, Mass.

Curtis, Frank Mitchell, I, '06 (D). Retail Lumber, Wm. Curtis Sons Company, 10 Blue Hill Avenue, Milton, Mass.

Curtis, William Leavitt, II, '05 (C).

Cutler, Benjamin Winthrop, Jr., III, '04 (D). With Fred Butterfield & Co., Inc., 361 Broadway, New York City.

Cuttle, James H., II, '99 (D). Superintendent, S. Stroock & Co., Inc., Newburgh, N. Y.

Dalton, Gregory Smith, IV, '12 (D).

Darby, Avard Nelson, II, '28 (D). With Merrimac Hat Corporation, Amesbury, Mass.

Datar, Anant Vithal, VI, '24 (B.T.E.). Secretary and Manager, The Pulgaon Cotton Manufacturing Company, Ltd., Pulgaon, C. P., India.

Davidson, Sydney, III, '28 (D). 64 Devon Street, Roxbury, Mass.

Davieau, Alfred Edward, VI, '16 (D). Textile Engineer, in charge of Textile Testing, United States Testing Company, Inc., 316 Hudson Street, New York City.

Davieau, Arthur Napoleon, VI, '13 (D). Superintendent, Kenwood Mills, Ltd. (F. C. Huyck & Sons), Arnprior, Ont.

Davieau, Leon Arthur, VI, '23 (B.T.E.). With United States Rubber Company (Textile Section), 451 South Jefferson Street, Orange, N. J.

Davis, Alexander Duncan, VI, '14 (B.T.E.). Instructor, Northeastern University, Springfield, Mass.

Dearborn, Roy S., VI, '13 (D). Salesman, Dumas & Co., Lowell, Mass.

Dearth, Elmer Elbridge, IV, '12 (D). Manager, Product Development, Fisk Rubber Company, Chicopee Falls, Mass.

Del Plaine, Parker Haywood, IV, '25 (B.T.C.). Textile Chemist, Rohm & Haas Company, Bristol, Pa.

Derby, Roland Everett, IV, '22 (B.T.C.). Head Chemist, M. T. Stevens & Sons Company, North Andover, Mass.

de Sa, Francisco, VI, '18 (B.T.E.). Avenue da Graca, Bahia, Brazil.

Dewey, James French, II, '04 (D). Woolen Manufacturer, A. G. Dewey Company, Quechee, Vt.

Dewey, Maurice William, II, '11 (D). Inspector of Real Estate and Real Estate Loans, National Life Insurance Company, Montpelier, Vt.

Dillon, James Henry, III, '05 (D).

Dods, James Barber, II, '27 (D). Vice-President and General Manager, The Dods Knitting Company, Ltd., Orangeville, Ont.

Dolan, William Francis, IV, '28 (B.T.C.). Dyer, Lowell Bleachery, South, Griffin, Ga.

Donald, Albert Edward, II, '04 (D). Agent, H. T. Hayward Company, Franklin, Mass.

Donovan, Joseph Richard, IV, '24 (B.T.C.). Proprietor, Scientific Laundry, 484 Main Street, Charlestown, Mass.

Doran, Wilbur Kirkland, II, '22 (D). State Manager, Investors Syndicate, Providence, R. I.

Dorr, Clinton Lamont, VI, '14 (D). With Raymond's Syndicate, Inc., 356 Washington Street, Boston, Mass.

Douglas, Walter Shelton, II, '21 (D). Estimator, Douglas & Co., Lowell, Mass.

Duguid, Harry Wyatt, I, '24 (D). Assistant Superintendent, Maverick Mills, East Boston, Mass.

Dunnican, Edward Tunis, VI, '24 (B.T.E.). With Pacific Mills, 24 Thomas Street, New York City.

Durgin, William Ernest, IV, '24 (B.T.C.). With Geigy Company, Inc., 88 Broad Street, Boston, Mass.

Duval, Joseph Edward, II, '10 (D). Yarn Agent, 308 Chestnut Street, Philadelphia, Pa.

Dwight, John Francis, Jr., II, '08 (D). Proprietor, Humarock Inn, Humarock, Mass.

Echmalian, John Gregory, VI, '16 (B.T.E.). Director, State Trade School, South Manchester, Conn.

Ehrenfried, Jacob Benjamin, II, '07 (C). Manager, George Ehrenfried Company, Lewiston, Maine.

Elliot, Gordon Baylies, II, '12 (D). Production Work, Pacific Mills, Lawrence, Mass.

Ellis, Charles Albert, VI, '21 (B.T.E.). Engineer, City of Syracuse, Syracuse, N. Y.

Ellis, Dorothy Myrta, VI, '25 (B.T.E.). Junior Cotton Technologist, Department of Agriculture, Bureau of Home Economics, Washington, D. C.

Ellis, James Oliver, VI, '29 (B.T.E.). With Cheney Brothers, South Manchester, Conn.

Emerson, Frank Warren, II, '03 (D). 56 Washington Street, Penacook, N. H.

Engstrom, Karl Emil, VI, '12 (D). (**S.B. 1916, Massachusetts Institute of Technology.**) With Lockwood, Greene & Co., Boston, Mass.

Enloe, Winfred Paige, I, '22 (D). Assistant Superintendent, The W. A. Handley Manufacturing Company, Roanoke, Ala.

Evans, Alfred Whitney, III, '03 (D).

Evans, Paul Richard, II, '29 (D). With United Testing Company, New York City.

Evans, William Robinson, III, '03 (D). 309 Main Street, Bradford, Mass.

Everett, Charles Arthur, IV, '19 (B.T.C.). Instructor, Dyeing Department, Lowell Textile Institute, Lowell, Mass.

Ewer, Nathaniel Trull, IV, '01 (D). Chemist, American Dyewood Company, Chester, Pa.

Fairbanks, Almonte Harrison, II, '09 (D). Treasurer and Manager, Middlesex Knitting Company, Wakefield, Mass.

Farley, Clifford Albert, VI, '28 (B.T.E.). Cost Investigator, Thorndike Company, West Warren, Mass.

Farmer, Chester Jefferson, IV, '07 (D). (**Ph.D. Harvard University.**) Professor of Chemistry, Northwestern University Medical School, Chicago, Ill.

Farnsworth, Harold Vincent, VI, '16 (B.T.E.). Textile Engineer, Atkinson, Haserick & Co., 152 Congress Street, Boston, Mass.

Farr, Leonard Schaefar, II, '08 (D). Assistant Superintendent, No. 2 Mill, Farr Alpaca Company, Holyoke, Mass.

Farwell, Claude Chapman, VI, '23 (B.T.E.). Instructor, Mathematics and Physics, Story High School, Manchester, Mass.

Farwell, Ray Baldwin, VI, '24 (B.T.E.). Died July 6, 1926.

Fasig, Paul Leon, IV, '28 (B.T.C.). Industrial Fellow, Mellon Institute of Industrial Research, Pittsburgh, Pa.

Feinberg, Benjamin, II, '27 (D). Salesman, National Mill Supply Company, 184 Summer Street, Boston, Mass.

Feindel, George Paul, IV, '24 (B.T.C.). Chemist, Union Bleachery, Greenville, S. C.

Feldstein, Martin Alexander, VI, '24 (B.T.E.). Chief, The Best Radio Service Laboratories, Brooklyn, N. Y.

Fels, August Benedict, II, '99 (D).

Ferguson, Arthur Feiling, I, '03 (D). With United States Tariff Commission, Washington, D. C.

Ferguson, William Gladstone, III, '09 (D). Assistant Agent, Ludlow Manufacturing Associates, Ludlow, Mass.

Ferris, Arthur Leon, II, '28 (D). Port Rowan, Ont.

Finlay, Harry Francis, IV, '10 (D). Chemist and Demonstrator, National Aniline and Chemical Company, Boston, Mass.

Fisher, Russell Todd, VI, '14 (D), '25 (B.T.E.). Secretary, National Association of Cotton Manufacturers, 80 Federal Street, Boston, Mass.

Fiske, Starr Hollinger, II, '09 (D). Owner and Manager, Wing's Cash Market, Lowell, Mass.

Fitzgerald, John Francis, IV, '18 (B.T.C.). Dyer, Boston Dye House, Inc., Malden, Mass.

Fitzgerald, John Francis, IV, '28 (B.T.C.). Chemist, Southbridge Finishing Company, Southbridge, Mass.

Fleischmann, Meyer, IV, '20 (B.T.C.). Chief Chemist, Real Silk Hosiery Mills, Indianapolis, Ind.

Fleming, Frank Everett, IV, '06 (D). Overseer, Dyeing and Finishing, Goodall Worsted Company, Sanford, Maine.

Fletcher, Howard Varnum, III, '25 (D). With North Billerica Company, North Billerica, Mass.

Fletcher, Roland Hartwell, VI, '10 (D). With Pressed Steel Car Company, McKees Rocks, Pa.

Flood, Thomas Henry, IV, '27 (B.T.C.). Chemist, Delawanna Bleachery & Printing Co., Delawanna, N. J.

Flynn, Thomas Patrick, IV, '11 (D). Sales Manager, E. L. Thompson Chair Corporation, Baldwinsville, Mass.

Ford, Edgar Robinson, IV, '11 (D). Technical Superintendent, Sayles Biltmore Bleacheries, Biltmore, N. C.

Ford, Stephen Kenneth, IV, '28 (B.T.C.). Chemist, Cheney Brothers, South Manchester, Conn.

Forsaith, Charles Henry, VI, '20 (B.T.E.). Superintendent, Nashua Manufacturing Company (Jackson Mills), Nashua, N. H.

Forsaith, Ralph Allen, VI, '16 (B.T.E.). With Saco-Lowell Shops, 147 Milk Street, Boston, Mass.

Forsyth, Harold Downes, VI, '23 (B.T.E.). Treasurer, Wm. Forsyth & Sons Co., Lynn, Mass.

Foster, Boutwell Hyde, VI, '17 (B.T.E.). Manager, Textile Section, United States Rubber Company, 451 South Jefferson Street, Orange, N. J.

Foster, Clifford Eastman, II, '01 (D). 35 Mount Vernon Street, New Bedford, Mass.

Fowle, Edwin Daniels, VI, '24 (B.T.E.). Associate Editor, "Textile World," 10th Avenue at 36th Street, New York City.

Franks, Jerome, VI, '27 (B.T.E.). (M.S. 1929, Massachusetts Institute of Technology.) 357 Bushkill Street, Easton, Pa.

Fredrickson, Charles Joseph, Jr., IV, '29 (B.T.C.). Technical Research, National Leather Company, Peabody, Mass.

Frost, Harold Benjamin, II, '12 (D). Salesman, Liberty Mutual Insurance Company, Boston, Mass.

Fuller, Allen Reed, IV, '17 (B.T.C.). Textile Chemist, Federal Phosphorous Company, Anniston, Ala.

Fuller, George, I, '03 (D). Textile Consultant, Cox, Fuller and Mauersberger, 320 Broadway, New York City.

Gadsby, Arthur Norton, II, '13 (D). Deceased.

Gahm, George Leonhard, II, '06 (D). Superintendent, Yarn Department, Wood Worsted Mills, Lawrence, Mass.

Gainey, Francis William, IV, '11 (D). Assistant Superintendent, Cheney Brothers, South Manchester, Conn.

Gale, Harry Laburton, III, '10 (D). Sales Manager, Colored Goods Department, Iselin-Jefferson Company, 328 Broadway, New York City.

Gallagher, John Waters, II, '27 (D). With E. I. du Pont de Nemours & Co., Fairfield, Conn.

Garlick, Mrs. Dorothy M. (Burbeck, Dorothy M.), IV, '20 (B.T.C.). 192 Great Road, Maynard, Mass.

Gaudet, Walter Urban, II, '29 (D). Mill Department, Wellington, Sears & Co., 65 Worth Street, New York City.

Gay, Olin Dow, II, '08 (D). President, Gay Brothers Company, Cavendish, Vt.

Gerrish, Henry Kilborn, III, '16 (D). Died September 18, 1922.

Gerrish, Walter, III, '03 (D).

Gillie, Stanley James, I, '22 (D). Assistant Manager, United States Testing Company, Inc., 207 Chestnut Street, Philadelphia, Pa.

Gillon, Sara Agnes, IIIb, '06 (C).

Gilman, Ernest Dana, II, '26 (D). Assistant Designer, with Pacific Mills, Lawrence, Mass.

Glickman, Bernhardt Brecher, IV, '27 (B.T.C.). Student, Columbia University, New York City.

Godfrey, Harold Thomas, VI, '26 (B.T.E.). Textile Engineer, Davis & Furber Machine Co., North Andover, Mass.

Goldberg, George, VI, '10 (D). Salesman, Liberty Lace and Braid Company, 88 Bedford Street, Boston, Mass.

Goldenberg, Louis, VI, '27 (B.T.E.). Foreman and Mechanic of Knitting, Argus Knitting Mills, Lebanon, Pa.

Goldman, Moses Hyman, IV, '20 (B.T.C.). Textile Chemist, Eagle Dye Works, 396 Woodland Street, Hartford, Conn.

Goller, Harold Poehlmann, II, '23 (D). Sales Department, Du Pont Rayon Company, Old Hickory, Tenn.

Goodhue, Amy Helen, IIIb, '00 (C). See Harrison, Mrs. Arthur.

Gooding, Francis Earle, IV, '19 (B.T.C.). General Foreman, Calco Chemical Company, Bound Brook, N. J.

Goosetrey, Arthur, IV, '21 (B.T.C.). 14 Spring Street, Crompton, R. I.

Goosetrey, John Thomas, IV, '21 (B.T.C.). Chemist and Dyer, Rhode Island Lace Company, Inc., West Barrington, R. I.

Gottschalck, Lawrence William, VI, '28 (B.T.E.). With Scott and Williams, Inc., 366 Broadway, New York City.

Gould, Norman Culver, VI, '19 (B.T.E.). Textile Engineer, F. C. Huyck & Sons, Albany, N. Y.

Greenbaum, Herbert Baron, III, '29 (D). Salesman, American Woolen Company of New York, 38 Chauncy Street, Boston, Mass.

Greenberg, Archie, II, '21 (D). Treasurer, M. H. Corash Company, Inc., Worcester, Mass.

Greenwood, John Roger, Jr., II, '27 (D). 89 West Main Street, Millbury, Mass.

Guild, Lawrence Winfield, VI, '27 (B.T.E.). Salesman, Du Pont Rayon Company, 941 Hospital Trust Building, Providence, R. I.

Gwinnell, George Harry, II, '25 (D). Designer, Berkshire Woolen Company, Pittsfield, Mass.

Gyzander, Arne Kolthoff, IV, '09 (D). With National Aniline and Chemical Co., 40 Rector Street, New York City.

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Haddad, Nassib, VI, '23 (B.T.E.). Textile Engineer, United States Rubber Company, Orange, N. J.

Hadley, Richard Francis, IV, '22 (B.T.C.). Vice-President, Carbon Coal & Coke Company, 80 Federal Street, Boston, Mass.

Hadley, Walter Eastman, IV, '08 (D). Chemist, The Clark Thread Company, Newark, N. J.

Hadley, Wilfred Nourse, II, '22 (D). Salesman, Parks & Woolson Company, Springfield, Vt.

Hager, Hazen Otis, II, '21 (C). Treasurer and Manager, Suburban Gas and Equipment Company, Portland, Maine.

Hall, Frederick Kilby, VI, '24 (B.T.E.). Assistant Textile Technologist, United States Bureau of Standards, Washington, D. C.

Halsell, Elam Ryan, I, '04 (C). Assistant Superintendent, Whittenton Manufacturing Company, Taunton, Mass.

Hammond, Chester Twombly, II, '23 (D). Wool Department, Mohawk Carpet Mills, Inc., Amsterdam, N. Y.

Hanscom, Edwin Thomas, II, '27 (D). Assistant Superintendent, Hartford Woolen Mills, Hartford, Vt.

Hardie, Newton Gary, I, '23 (D). Superintendent, Oconee Mills Company, Westminster, S. C.

Hardy, Philip Lewis, VI, '10 (D). Contractor, Andover, Mass.

Harmon, Charles Francis, I, '99 (D).

Harrington, Thomas, IV, '15 (D). Superintendent, Monarch Leather Company, 1127 West Division Street, Chicago, Ill.

Harris, Charles Edward, I, '05 (D). Manager, Martin Fifth Wheel and Trailer Corporation, Easthampton, Mass.

Harris, George Simmons, I, '02 (C). President and Manager, Exposition Cotton Mills, Atlanta, Ga.

Harrison, Mrs. Arthur (Goodhue, Amy Helen), IIIb, '00 (C). R. F. D. No. 2, Lowell, Mass.

Hart, Arthur Norman, IV, '19 (B.T.C.).

Hart, Howard Roscoe, I, '23 (D). Superintendent, Victory Manufacturing Company, Fayetteville, N. C.

Haskell, Spencer Howard, II, '07 (D). Deceased.

Haskell, Walter Frank, IV, '02 (D). Overseer of Dyeing, Dana Warp Mills, Westbrook, Maine.

Hassett, Paul Joseph, IV, '12 (D). Production Manager, Cortland Works, L. C. Smith & Corona Typewriters, Inc., Syracuse, N. Y.

Hathaway, William Tabor, II, '26 (D). With Hampton Company, Easthampton, Mass.

Hathorn, George Wilmer, IV, '07 (D). Chemist, Lawrence Gas Company, Lawrence, Mass.

Hathorne, Berkeley Lewis, IV, '24 (B.T.C.). Research Chemist, Tubize Artificial Silk Company, 2 Park Avenue, New York City.

Hay, Ernest Crawford, II, '11 (D). Superintendent, Monomac Spinning Company, Lawrence, Mass.

Haynes, Amos Kempton, IV, '29 (B.T.C.). Textile Research Chemist, Rohm & Haas Co., Bristol, Pa.

Hendrickson, Walter Alexander, II, '11 (D). With National Knitting Company, 905 Clinton Street, Milwaukee, Wis.

Hennigan, Arthur Joseph, II, '06 (D). President, Seneca Manufacturing Company, and New England Representative, Cox & Schreiber, of New York, 225 Fourth Avenue, New York City.

Hetherman, Patrick Joseph, IV, '29 (B.T.C.). Dyer, Standardization Department, National Aniline Dyestuff Corporation of America, Buffalo, N. Y.

Hibbard, Frederick William, IV, '25 (B.T.C.). Salesman, Twin Mutuals Insurance Companies, Lawrence, Mass.

Hildreth, Harold William, II, '07 (D). Draftsman, C. G. Sargent's Sons Corporation, Graniteville, Mass.

Hillman, Ralph Greeley, VI, '22 (B.T.E.). Assistant Superintendent, Samson Cordage Works, Shirley, Mass.

Hindle, Milton, VI, '25 (B.T.E.). With Barre Wool Combing Company, Ltd., South Barre, Mass.

Hintze, Thomas Forsyth, I, '06 (C).

Hodge, Harold Bradley, VI, '22 (B.T.E.). Plant Layout Department, Cheney Brothers, South Manchester, Conn.

Hoffman, Richard Robert, II, '21 (C).

Holbrook, Ralph Wentworth, IV, '29 (B.T.C.). Textile Colorist and Chemist, General Dyestuff Corporation, 230 Fifth Avenue, New York City.

Holden, Francis Crawford, IV, '09 (D). Chemist, Chelsea Fibre Mills, 1155 Manhattan Avenue, Brooklyn, N. Y.

Holden, John Sanford, II, '20 (D). Manufacturer, Automatic Machine Products Company, Attleboro, Mass.

Holgate, Benjamin, III, '02 (C). Agent, Boott Mills, Lowell, Mass.

Hollings, James Louis, I, '05 (D). Buyer and Converter (Cotton Goods), W. R. Grace & Co., 7 Hanover Square, New York City.

Hollstein, William Diedrick, VI, '25 (B.T.E.). Junior Salesman, Schwarzenbach, Huber & Co., New York City.

Holmes, Otis Milton, VI, '13 (B.T.E.). Draftsman, United Shoe Machinery Corporation, Beverly, Mass.

Holt, Laurence Currier, VI, '29 (B.T.E.). With Pacific Mills, Lawrence, Mass.

Hood, Leslie Newton, IV, '12 (D). Chemist, Union Bleachery, Greenville, S. C.

Hook, Russell Weeks, IV, '05 (D). Textile Chemist, Arthur D. Little, Inc., 30 Charles River Road, Cambridge, Mass.

Hooper, Clarence, IV, '27 (B.T.C.). Chemist, Sayles Finishing Plants, Inc., Saylesville, R. I.

Horne, James Albert, I, '24 (D). Mill Department, Wellington, Sears & Co., 65 Worth Street, New York City.

Horsfall, George Gordon, II, '04 (C). Assistant Dyer, Interwoven Mills, Inc., Martinsburg, W. Va.

Horton, Chester Temple, VI, '14 (B.T.E.). Wilmington, Mass.

Houghton, Robert Kingsbury, IV, '23 (B.T.C.). Chemist, Cheney Brothers, South Manchester, Conn.

Howarth, Charles Lincoln, IV, '17 (B.T.C.). Assistant Professor of Dyeing, Lowell Textile Institute, Lowell, Mass.

Howe, Woodbury Kendall, I, '10 (D). Assistant Superintendent, Merrimack Manufacturing Company, Lowell, Mass.

Hoyt, Charles William Henry, IV, '07 (D).

Hsu, Hsueh-Chang, VI, '23 (B.T.E.).

Hubbard, Harold Harper, I, '22 (D). Technical Assistant, National Association of Cotton Manufacturers, 80 Federal Street, Boston, Mass.

Hubbard, Ralph King, IV, '11 (D). President and Treasurer, Packard Mills, Inc., Webster, Mass.

Huising, Gerónimo Huerva, I, '08 (D). Farmer, Hda "Perseverancia," San José, Mindoro, P. I.

Hunt, Chester Lansing, III, '05 (C).

Hunton, John Horace, II, '11 (D). With Nashua Manufacturing Company, Nashua, N. H.

Hurd, Ira Swain, IV, '29 (B.T.C.). Textile Colorist, General Dyestuff Corporation, 230 Fifth Avenue, New York City.

Hurtado, Leopoldo, Jr., VI, '10 (D). General Manager, Hurtado & Co., Uruapan, Michoacán, Mex.

Hurwitz, Jacob, IV, '23 (B.T.C.).

Hutton, Clarence, III, '03 (C). Editor, "The Melliand," Woolworth Building, New York City.

Hyman, Wolfred, II, '28 (D). 36 Schuyler Street, Roxbury, Mass.

Irvine, James Andrew, VI, '17 (B.T.E.). Manager of Employment and Training, Cheney Brothers, South Manchester, Conn.

Isaacson, George Franklin, II, '26 (D). With Clarence S. Brown & Co., 40 Worth Street, New York City.

Jaeger, Robert William, Jr., IV, '23 (B.T.C.). Technical Division, Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago, Ill.

Jelleme, William Oscar, I, '10 (D). With Pacific Mills, 24 Thomas Street, New York City.

Jen, Shang Wu, I, '21 (D).

Jenckes, Leland Aldrich, VI, '08 (D). Deceased.

Jessop, Charles Clifford, VI, '22 (B.T.E.) Textile Engineer, Pacific Mills, 24 Thomas Street, New York City.

Johnson, Arthur Kimball, IV, '13 (D). (**S.B. 1917, Massachusetts Institute of Technology.**) Rayon Research Chemist, Cheney Brothers, South Manchester, Conn.

Johnson, George Henry, IV, '20 (B.T.C.). Director of Research, Laundry Owners National Association, Joliet, Ill.

Johnson, Philip Stanley, IV, '24 (B.T.C.). Color Chemist and Sales Manager, Tizian Color Company, 25 Arch Street, Boston, Mass.

Jones, Everett Amos, III, '05 (D). Superintendent, Nye & Wait Kilmarnock Corporation, Auburn, N. Y.

Jones, Nathaniel Erskine, I, '21 (D). Assistant Superintendent, E. L. Watkins, 612 Forest Avenue, Portland, Maine.

Joslin, Harold Wheeler, II, '28 (D). Second Hand, Finishing, Souhegan Woolen Company, Wilton, N. H.

Joy, Thomas, VI, '26 (B.T.E.). Production Engineer, Thorndike Company, West Warren, Mass.

Jury, Alfred Elmer, IV, '04 (D). Agent, United States Rubber Company, (Winnsboro Mills), Winnsboro, S. C.

Kaatze, Julius, VI, '22 (B.T.E.). Salesman, Toledo Scale Company, Lawrence, Mass.

Kao, Chieh-Ching, VI, '23 (B.T.E.).

Karanfilian, John Hagop, VI, '21 (B.T.E.).

Kay, Harry Pearson, II, '09 (D). Associate Member, Stanford Wright Agency, Penn Mutual Life Insurance Company, Boston, Mass.

Kendall, Charles Henry, II, '23 (D). Superintendent, Bridgewater Woolen Company, Bridgewater, Vt.

Kennedy, Francis Charles, VI, '26 (B.T.E.). Product Development Department, The Fisk Rubber Company, Chicopee Falls, Mass.

Kenney, Frederick Leo, II, '27 (D). Assistant Designer, Uxbridge Worsted Company, Uxbridge, Mass.

Kent, Clarence LeBaron, III, '06 (C). Sales Manager, Standard Oil Company, Portland, Maine.

Keough, Wesley Lincoln, II, '10 (D). With E. A. Pierce & Co., New York Stock Exchange, Pasadena, Calif.

Killheffer, John Vincent, IV, '28 (B.T.C.). Textile Chemist, Newport Chemical Works, Inc., Greenville, N. C.

Kingsbury, Percey Fox, IV, '01 (D). Print Manager, Passaic Print Works, Passaic, N. J.

Knowland, Daniel Power, IV, '07 (D). Chief Chemist, Geigy Company, Inc., 89 Barclay Street, New York City.

Knox, Joseph Carleton, VI, '23 (B.T.E.). Assistant Sanitary Engineer, State Department of Health, Boston, Mass.

Kuo, Limao, VI, '26 (B.T.E.). In charge of Quality Testing Division, Shanghai Bureau of Inspection and Testing of Commercial Commodities, Shanghai, China.

Lakeman, Fannie Shillaber, IIIb, '00 (C). Died February 8, 1921.

Lamb, Arthur Franklin, II, '10 (D). In business, Cleansing and Dyeing, Rockland, Maine.

Lamont, Robert Laurence, II, '12 (D).

Lamprey, Leslie Balch, IV, '16 (B.T.D.). 18 Holton Street, Lawrence, Mass.

Lamson, George Francis, I, '00 (D). With Ludlow Manufacturing Associates, Ludlow, Mass.

Lane, John William, I, '06 (C).

Lane, Oliver Fellows, IV, '15 (B.T.D.). Chemist, Head of Color Making Department, Lowe Paper Company, Ridgefield, N. J.

Larratt, John Francis, II, '22 (D). With Mohawk Carpet Company, Amsterdam, N. Y.

Laughlin, James Knowlton, III, '09 (D).

Laurin, Eric Thursten Lawrence, IV, '21 (B.T.C.). Assistant Chief Chemist, Sayles Finishing Plant, Saylesville, R. I.

Laurin, Sven Albert, IV, '23 (B.T.C.). Student, Boston University, Boston, Mass.

Leach, John Pelopidas, I, '00 (C). Farming, Mosby Hall Farm, Littleton, N. C.

Leavitt, George Herbert, II, '26 (D). Inspector, F. C. Huyck & Sons, Albany, N. Y.

Lee, William Henry, II, '05 (C). Manager, Graves Hall & Co., Inc., New Haven, Conn.

Leitch, Harold Watson, IV, '14 (B.T.D.). Assistant Superintendent, Dyeing and Finishing, Pacific Mills, Lawrence, Mass.

Lemire, Joseph Emile, VI, '21 (B.T.E.). Sub-Master, Pepperell High School, Pepperell, Mass.

Leonard, Leo Edward, I, '27 (D). 115 West Street, Worcester, Mass.

Levi, Alfred Sandel, IV, '09 (D). President, Liondale Bleach, Dye and Print Works, Rockaway, N. J.

Lewis, George Kenneth, VI, '24 (B.T.E.). Mechanical Experimental Engineer, Du Pont Rayon Company, Buffalo, N. Y.

Lewis, LeRoy Clark, IV, '08 (D). Representative, Kawanoishi Seishi Kaisha, 404 Fourth Avenue, New York City.

Lewis, Walter Scott, IV, '05 (D). Special Expert in Textiles, United States Tariff Commission, Washington, D. C.

Lillis, Marvin Hale, IV, '14 (D). With Marland Mills, Andover, Mass.

Lindsly, Walter Coburn, IV, '29 (B.T.C.). Textile Chemist, Bigelow Sanford Carpet Company, Thompsonville, Conn.

Linsey, Edward, II, '25 (D). Production Department, Mohawk Carpet Mills, Inc., Amsterdam, N. Y.

Logan, George Leslie, VI, '28 (B.T.E.). Textile Engineer, Assistant to Vice-President, Tompkins Brothers Company, Syracuse, N. Y.

Lombard, Carleton Joshua, VI, '23 (B.T.E.). Salesman, Rodney Hunt Machine Company, Orange, Mass.

Loney, Robert William, II, '22 (D). With General Electric Company, Schenectady, N. Y.

Longbottom, Parker Wyman, IV, '21 (B.T.C.). Chemist and Dyer, Claremont Waste Manufacturing Company, Claremont, N. H.

Lowe, Philip Russell, VI, '24, (B.T.E.). Inspector, Associated Factory Mutual Fire Insurance Company, Boston, Mass.

Lucey, Edmund Ambrose, II, '04 (D). Consulting Engineer and Textile Specialist, Edmund A. Lucey & Co., 53 Park Place, New York City.

Lussier, Joseph Adrien, II, '27 (D). Staff Superintendent, Hood Rubber Company, East Watertown, Mass.

McCann, John Joseph, Jr., VI, '24 (B.T.E.).

McCool, Frank Leslie, IV, '10 (D). With S. R. David & Co., Inc., 252 Congress Street, Boston, Mass.

Macdonald, Hector Graham, IV, '19 (B.T.C.). Superintendent of Dyeing, Franklin Process Company, Providence, R. I.

McDonnell, William Henry, I, '06 (C). Lawyer, McDonnell & White, 40 Court Street, Boston, Mass.

McGowan, Frank Robert, VI, '15 (B.T.E.). Textile Engineering Adviser, Cotton-Textile Institute, Inc., 320 Broadway, New York City.

McGowan, Henry Earl, VI, '22 (B.T.E.). Instructor, Lowell High School, Lowell, Mass.

McGuire, Edward Perkins, VI, '28 (B.T.E.). General Merchandiser, Associated Dry Goods Corporation, 17 East 39th Street, New York City.

Mackay, Stewart, III, '07 (D). Assistant Professor of Textile Design, Lowell Textile Institute, Lowell, Mass.

McKay, Benedict Josephus, IV, '28 (B.T.C.). Chemist, Merrimack Manufacturing Company, Lowell, Mass.

McKenna, Hugh Francis, IV, '05 (D). Chicago Manager, United Indigo and Chemical Company, Ltd., 218 West Kinzie Street, Chicago, Ill.

McKinnon, Norman, VI, '29 (B.T.E.). Textile Testing, Fabric Department, Goodyear Tire & Rubber Co., Akron, Ohio.

McKinstry, James Bradley, II, '25 (D). Superintendent, Millbury Woolen Company, Millbury, Mass.

McKittrick, Raymond Wellington, VI, '28 (B.T.E.). Textile Engineer, F. C. Huyck & Sons, Albany, N. Y.

MacPherson, Wallace Angus, III, '04 (D). Designer, Wuskanut Mills, Inc. (S. Slater & Sons), Farnumsville, Mass.

Macher, Henry, II, '23 (D). Industrial Research Work, Botany Worsted Mills, Passaic, N. J.

Maguire, James Joseph, II, '28 (D). Assistant Designer, Glenark Mill (Uxbridge Worsted Company), Woonsocket, R. I.

Mahoney, George Stephen, VI, '22 (B.T.E.). Overseer, Franklin Cotton Mill Company, Cincinnati, Ohio.

Mailey, Howard Twisden, II, '08 (D). Manufacturing Superintendent, Worsted Yarns, Pacific Mills, Lawrence, Mass.

Manning, Frederick David, IV, '10 (D). Planning Department, Pacific Mills, Lawrence, Mass.

Marinel, Walter Newton, I, '01 (D). Automobile Repairing, North Chelmsford, Mass.

Mark, Aris Sawa, VI, '22 (B.T.E.). Sales Department, Overton Textile Company, New York City.

Marshall, Chester Stanley, II, '22 (D). Salesman, Du Pont Rayon Company, 1504 Land Title Building, Philadelphia, Pa.

Martin, Harry Warren, IV, '11 (D). Management Department, Hood Rubber Company, Watertown, Mass.

Mason, Archibald Lee, VI, '09 (D). With Merrimack Woolen Company, Dracut, Mass.

Mason, Philip Edwin, IV, '26 (B.T.C.). Salesman and Chemist, Watson Park Company, 470 Atlantic Avenue, Boston, Mass.

Mather, Harold Thomas, VI, '13 (D). Inspector, Associated Factory Mutual Fire Insurance Companies, Boston, Mass.

Mathieu, Alfred Jules, II, '20 (D). Salesman, Wools and Commission Dyeing, Woonsocket, R. I.

Matthews, Elmer Clark, II, '17 (D). Superintendent, Thermo Mills, Inc., West Sand Lake, N. Y.

Matthews, Robert Jackson, VI, '29 (B.T.E.). With Pacific Mills, 24 Thomas Street, New York City.

Mauersberger, Herbert Richard Carl, III, '18 (D). Of Cox, Fuller & Mauersberger, 320 Broadway, New York City.

Mazer, Samuel, IV, '26 (B.T.C.). In business, Wilber Skein Dyeing Company, Hyde Park, Mass.

Meadows, William Ransom, I, '04 (D). Cotton Registrar, Chicago Board of Trade, Chicago, Ill.

Meek, Lotta, IIIb, '07 (C). See Parker, Mrs. Herbert L.

Meeker, Samuel, IV, '27 (B.T.C.). Textile Chemist, Textile Dyeing Company of America, Hawthorne, N. J.

Merchant, Edith Clara, IIIb, '00 (C). Supervisor of Art, Lowell, Mass.

Merrill, Allan Blanchard, IV, '11 (D). Manager, Development Department, B. F. Goodrich Company, Akron, Ohio.

Merrill, Gilbert Roscoe, VI, '19 (B.T.E.). Professor of Textiles; in charge of Cotton Yarn Department, Lowell Textile Institute, Lowell, Mass.

Merrill, John Leslie, VI, '27 (B.T.E.). Instructor in Weaving, Lowell Textile Institute, Lowell, Mass.

Merriman, Earl Cushing, II, '07 (D). Died September 30, 1918.

Meyers, Chester William, IV, '27 (B.T.C.). Second Hand in Dyehouse, Massachusetts Knitting Mills, Jamaica Plain, Mass.
Midwood, Arnold Joseph, IV, '05 (D). Salesman, Dyestuffs Corporation of America, 281 Franklin Street, Boston, Mass.
Miller, Joshua, VI, '24 (B.T.E.). Associate Aeronautical Textiles Engineer, Navy Department, Washington, D. C.
Minge, Jackson Chadwick, I, '01 (C).
Mirsky, Leon Robert, II, '19 (D). 229 West 97th Street, Apartment 3-B, New York City.
Mitchell, Charles Alvah, II, '24 (D). Assistant Superintendent of Woolen Department, Roxbury Carpet Company, Saxonville, Mass.
Moller, Ernest Arthur, II, '22 (D). Salesman, The Goodyear Tire & Rubber Co., Inc., Boston, Mass.
Molloy, Francis Henry, II, '16 (D). With The William Carter Company, New York City.
Moore, Edward Francis, II, '25 (D). Planning Department, Rockford Mitten and Hosiery Company, Rockford, Ill.
Moore, Everett Byron, I, '05 (D). President, Chadbourne & Moore, Inc., Chelsea, Mass.
Moore, Karl Remick, IV, '11 (D). Assistant Superintendent, Lorraine Manufacturing Company, Pawtucket, R. I.
Moore, William Joseph, IV, '21 (B.T.C.). Colorist, Pacific Mills, Lawrence, Mass.
Moorhouse, William Roy, IV, '01 (D). With National Aniline and Chemical Company, Inc., 40 Rector Street, New York City.
Morrill, Howard Andrew, VI, '16 (D). Assistant Agent, Postex Cotton Mills, Post, Texas.
Morris, Merrill George, IV, '21 (B.T.C.). Chemist-in-charge, Philadelphia Laboratory, National Aniline & Chemical Co., 200 South Front Street, Philadelphia, Pa.
Morrison, Fred Clifton, I, '03 (D). Died August 21, 1919.
Morrison, Haven Asa, IV, '25 (B.T.C.). Overseer of Dyeing, The Barre Wool Combing Company, Ltd., South Barre, Mass.
Mullaney, John Francis, VI, '20 (B.T.E.). Salesman, Saco-Lowell Shops, Newton Upper Falls, Mass.
Mullen, Arthur Thomas, II, '09 (D). Superintendent, Maine Woolen Mills, Inc., Camden, Maine.
Munroe, Sydney Philip, I, '12 (D). Manager, Ralph E. Loper & Co., Greenville, S. C.
Murray, James, IV, '13 (D). P. O. Box 613, Woonsocket, R. I.
Murray, James Andrew, II, '10 (D). Chocolate Manufacturer, Murene Chocolate Company, 162 Commercial Street, Boston, Mass.
Myers, Walter Flemings, VI, '29 (B.T.E.). Assistant Superintendent, United States Bunting Company, Lowell, Mass.

Najar, G. George, IV, '03 (D). Dyer and Bleacher, Monument Mills, Housatonic, Mass.
Nary, James Anthony, II, '22 (D). Manager, Chicago Testing House, United States Testing Company, Inc., Chicago, Ill.
Nelson, Roy Clayton, II, '21 (C). Designer, Assabet Mills, Maynard, Mass.
Nelson, Russell Sprague, VI, '22 (B.T.E.). Cost Department, Draper Corporation, Hopedale, Mass.
Neugroschl, Sigmond Israel, I, '21 (D).
Newall, John Douglas, IV, '09 (D). Divisional Superintendent, Arnold Print Works, North Adams, Mass.
Newcomb, Guy Houghton, IV, '06 (C). Manager, Philadelphia Office, E. I. du Pont de Nemours & Co., 128 South Front Street, Philadelphia, Pa.
Neyman, Julius Ellis, IV, '15 (B.T.D.). Furniture Dealer, Neyman Furniture Company, 193–199 Middlesex Street, Lowell, Mass.
Nichols, Raymond Elmore, VI, '10 (D). Chief Draftsman, H. E. Fletcher Company, West Chelmsford, Mass.

Niven, Robert Scott, VI, '12 (D). Drafting Department, General Electric Company, Lynn, Mass.

Nostrand, Mrs. William L. (Conklin, Jennie Grace), IIIb, '05 (C). 35 87th Street, Bay Ridge, Brooklyn, N. Y.

O'Brien, Philip Francis, II, '15 (D). (B.S. New York University, M.A. Fordham University.) Chairman, Textile Department, New York Textile High School, New York City.

O'Connell, Clarence Edward, IV, '11 (D). Dyer, National Aniline and Chemical Company, Buffalo, N. Y.

O'Connor, Lawrence Dennis, VI, '17 (D). With Beggs & Cobb, Winchester, Mass.

O'Donnell, John Delaney, I, '04 (C).

O'Hara, William Francis, IV, '04 (C).

Olson, Carl Oscar, II, '24 (D). Scheduling Department, Cheney Brothers, South Manchester, Conn.

Orr, Andrew Stewart, IV, '22 (B.T.C.). Manager, Storey & Co., Brockton, Mass.

Osborne, George Gordon, VI, '28 (B.T.E.). Assistant Professor of Knitting and Designing, North Carolina State College, Raleigh, N. C.

Othote, Louis Joseph, I, '23 (D). Designer and Stylist, T. Holt Haywood Department, 65 Leonard Street, New York City.

Palais, Samuel, IV, '18 (B.T.C.). Chief of Planning Department, Durrell Company, 1 Beacon Street, Boston, Mass.

Parigian, Harold Hrant, IV, '28 (B.T.C.). Research Chemist, Cambridge Rubber Company, Cambridge, Mass.

Parker, B. Moore, I, '01 (D). Died December 11, 1918.

Parker, Everett Nichols, I, '05 (D). President, Parker Spool and Bobbin Company, 27–53 Middle Street, Lewiston, Maine.

Parker, Harry Carmi, III, '00 (C). 61 Arlington Street, Boston, Mass.

Parker, Mrs. Herbert L. (Meek, Lotta L.), IIIb, '07 (C). 4 Brookside Circle, Auburn, Maine.

Parker, Hubert Frederic, VI, '20 (B.T.E.). Assistant to Engineer, Castanea Paper Company, Lock Haven, Pa.

Parkin, Robert Wilson, VI, '27 (B.T.E.). Cost Accountant, Limerick Mills, Limerick, Maine.

Parkis, William Lawton, I, '09 (D). Assistant Superintendent, Cheney Brothers, South Manchester, Conn.

Parsons, Charles Sumner, VI, '27 (B.T.E.). With Hathaway Manufacturing Company, New Bedford, Mass.

Peabody, Roger Merrill, II, '16 (D). Superintendent, Belamose Corporation, Rocky Hill, Conn.

Pearlstein, Maxwell, III, '28 (D). 37 Lawrence Avenue, Roxbury, Mass.

Pearson, Alfred Henry, IV, '11 (D). Salesman, Ciba Company, Inc., 93 Broad Street, Boston, Mass.

Pease, Chester Chapin, I, '09 (D). Agent, Columbian Mills (Otis Company), Greenville, N. H.

Peck, Carroll Wilmot, IV, '13 (D). Vice-President, George Mann & Co., Inc., Providence, R. I.

Pensel, George Robert, IV, '13 (B.T.D.). Vice-President, Ritter Chemical Company, Inc., Amsterdam, N. Y.

Perkins, John Edward, III, '00 (D). Superintendent, S. N. & C. Russell Manufacturing Company, Pittsfield, Mass.

Perkins, Joshua Dean, III, '08 (D). Special Agent, Penn Mutual Life Insurance Company, Manchester, N. H.

Perlman, Samuel, IV, '17 (B.T.C.). 506 Belmont Avenue, Newark, N. J.

Perlmuter, Barney Harold, IV, '23 (B.T.C.). Credit Manager, American Furniture Company, Boston, Mass.

Petty, George Edward, I, '03 (C). With Jefferson Standard Insurance Company, Greensboro, N. C.

Phaneuf, Maurice Philippe, III, '20 (D). Draftsman, Johns-Manville Corporation, Nashua, N. H.

Phelan, Bernard Michael, IV, '29 (B.T.C.). With National Aniline and Chemical Co., 351 Abbott Road, Buffalo, N. Y.

Pierce, George Whitwell, IV, '25 (B.T.C.). Assistant Superintendent of Dyeing, Celanese Corporation of America, Cumberland, Md.

Pillsbury, Ray Charles, I, '13 (D). Manager, Manufacturing Standards Department, Cheney Brothers, South Manchester, Conn.

Plaisted, Webster E., II, '18 (D). Superintendent of Woolens, Pacific Mills (Worsted Division), Lawrence, Mass.

Plummer, Elliott Barton, IV, '13 (D). Died January 14, 1919.

Potter, Carl Howard, I, '09 (D). Treasurer and Manager, Globe Yarn Mills, Mt. Holly, N. C.

Pottinger, James Gilbert, II, '12 (D). Piece Goods Buyer, Reliance Manufacturing Company, 212 West Monroe Street, Chicago, Ill.

Powers, Walter Wellington, IV, '20 (B.T.C.). Superintendent, Lacquer Division, Fiberloid Corporation, Indian Orchard, Mass.

Pradel, Alois Joseph, III, '00 (D). Designer, Killingly Worsted Company, Danielson, Conn.

Pradel, Mrs. Alois J. (Walker, Anna G.). IIIb, '03 (C). 78 Broad Street, Danielson, Conn.

Precourt, Joseph Octave, VI, '21 (B.T.E.). Western Sales Manager, Cayuga Linen and Cotton Mills, Inc., 437 West Ontario Street, Chicago, Ill.

Prescott, Walker Flanders, IV, '09 (D). Sales Manager, Prescott & Co., Reg'd, 637 Craig Street, West, Montreal, Can.

Prince, Sylvanus Cushing, VI, '08 (D).

Proctor, Braman, IV, '08 (D). Salesman, General Dyestuff Corporation, 159 High Street, Boston, Mass.

Putnam, George Ives, IV, '16 (B.T.D.). Chief Chemist, McLoughlin Textile Corporation, Utica, N. Y.

Putnam, Leverett Nelson, IV, '10 (D). Overseer of Dyeing, Pacific Mills, Lawrence, Mass.

Putnam, Philip Clayton, IV, '13 (D). Foreman Dyer, Apponaug Company, Apponaug, R. I.

Quinlan, William Harold, VI, '20 (B.T.E.). Research Assistant, Warren Technical Service, Inc., 38 Charles River Road, Cambridge, Mass.

Radford, Garland, II, '20 (D). Vice-President, Oriental Textile Mills, Houston, Texas.

Ramsdell, Theodore Ellis, I, '02 (D). Vice-President and Agent, Monument Mills, Housatonic, Mass.

Rasche, William August, III, '03 (D). Deceased.

Raymond, Charles Abel, IV, '07 (D). Superintendent, New England Fuel and Transportation Co., Everett, Mass.

Redding, Leslie Capron, II, '26 (D). Designer, Selden Worsted Mills, Methuen, Mass.

Reed, Norman Bagnell, I, '10 (D). President and Treasurer, Lowell Mills Company, Lowell, Mass.

Reinhold, Kurt Herman, VI, '28 (B.T.E.). Statistician, Russell Manufacturing Company, Middletown, Conn.

Reynolds, Fred Bartlett, II, '08 (D). Purchasing Agent, M. T. Stevens & Sons Company, North Andover, Mass.

Reynolds, Isabel Halliday, III, '03 (C). Clerk, Pacific Mills Print Works, Lawrence, Mass.

Reynolds, Raymond, II, '24 (D). Supervisor, Du Pont Rayon Company, Buffalo, N. Y.

Rice, Josiah Alfred, Jr., III, '20 (D). Manager, Wholesale Ginghams & Wool Goods, Marshall Field & Co., Chicago, Ill.

Rice, Kenneth Earl, VI, '29 (B.T.E.). With Firestone Cotton Mills, Fall River, Mass.

Rich, Edward, IV, '15 (B.T.D.). Merchant, Jackson Caldwell Company, East Boston, Mass.

Rich, Everett Blaine, III, '11 (D). Onacove Sewall Road, Wolfeboro, N. H.

Rich, Milton Scott, II, '22 (D). Assistant to Purchasing Agent, Harvard University, Cambridge, Mass.

Richardson, George Oliver, IV, '16 (B.T.D.). Manager, Tientsin Office, National Aniline and Chemical Company, Inc., Tientsin, China.

Richardson, Richardson Perry, I, '13 (D). Salesman, H. F. Livermore Company, Boston, Mass.

Riggs, Homer Chase, VI, '17 (B.T.E.). Sales Engineer, Rodney Hunt Machine Company, Orange, Mass.

Ripley, George Keyes, II, '17 (D). Vice-President and General Manager, Troy Blanket Mills, Troy, N. H.

Rivers, William Anthony, II, '24 (D). Assistant Superintendent and Designer, The A. G. Dewey Company, Quechee, Vt.

Roberson, Pat Howell, I, '05 (C). Vice-President, Union State Bank, Pell City, Ala.

Roberts, Carrie Isabel, IIIb, '05 (C). Craft Work, 37 Grace Street, Lowell, Mass.

Robinson, Ernest Warren, IV, '08 (D). Manager Silk Department, J. & P. Coats, Inc., Pawtucket, R. I.

Robinson, Russell, VI, '21 (B.T.E.). Superintendent, Textile Department, Celanese Corporation of America, Amcelle, Md.

Robinson, William Albert, II, '25 (D). 26 Chauncy Street, Suite 5, Cambridge, Mass.

Robinson, William Carleton, III, '03 (C). With American Wool and Cotton Reporter, 530 Atlantic Avenue, Boston, Mass.

Robson, Frederick William Charles, IV, '10 (D).

Roche, Raymond Vincent, IV, '12 (D). Died September 10, 1926.

Rodalvicz, Francis Rudolph, IV, '28 (B.T.C.). Chemist, American Woolen Company, Andover, Mass.

Royal, Louis Merry, VI, '21 (B.T.E.). Mathematics Department, Pawtucket Senior High School, Pawtucket, R. I.

Rundlett, Arnold Dearborn, VI, '12 (D). Superintendent, Joseph Noone's Sons Company, Peterborough, N. H.

Runnells, Harold Nelson, IV, '25 (B.T.C.). Chemist, Holden-Leonard Company, Bennington, Vt.

Russell, John William, IV, '20 (B.T.C.). Chemist, American Lanolin Corporation, Lawrence, Mass.

Russell, William Samuel, Jr., VI, '28 (B.T.E.). With Johns-Manville Sales Corporation, 292 Madison Avenue, New York City.

Ryan, David Louis, II, '27 (D). Technician of Promotional Sales Department, American Glanzstoff Corporation, Lafayette Building, Philadelphia, Pa.

Ryan, Lawrence Francis, IV, '23 (B.T.C.). Chemist, Technical Laboratory, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

Ryan, Millard Kenneth Thomas, Jr., II, '24 (D). Assistant Manager, Shanghai International Testing House, Shanghai, China.

Ryberg, Bertil August, IV, '29 (B.T.C.). Student, Massachusetts Institute of Technology, Cambridge, Mass.

Sampson, Clifford William, IV, '28 (B.T.C.). Chemist, Boston Blacking Company, Boston, Mass.

Sanborn, Frank Morrison, VI, '19 (B.T.E.). Assistant Superintendent, American Net & Twine Co., West Kennebunk, Maine.

Sanborn, Ralph Lyford, VI, '16 (B.T.E.). Head of Cost Production and Timekeeping Department, Manville-Jenckes Company, Gastonia, N. C.

Sandlund, Carl Seth, VI, '25 (B.T.E.). Research Department, McCallum Silk Hosiery Company, Northampton, Mass.

Sargent, Robert Edward, IV, '25 (B.T.C.). Chemist, Nashua Manufacturing Company, 88 Broad Street, Boston, Mass.

Sargent, Walter Ambrose, I, '22 (D). Instructor, Textile Shop Practice, Public Schools, Passaic, N. J.
Saunders, Harold Fairbairn, IV, '09 (D). With Sherwin Williams Company, Chicago, Ill.
Savery, James Bryan, II, '23 (D). 1514 Engracia Avenue, Torrance, Calif.
Sawyer, Joseph Warren, IV, '15 (B.T.D.). Died May 6, 1926.
Sawyer, Richard Morey, VI, '27 (B.T.E.). (M.S., 1929, Massachusetts Institute of Technology.) Research Laboratory, Firestone Tire & Rubber Co., Akron, Ohio.
Scanlon, Andrew Augustine, IV, '26 (B.T.C.). 61 Salem Street, Lawrence, Mass.
Schaetzel, André Paul, IV, '21 (B.T.C.). Chemist, Associated Dyeing & Printing Corporation, Paterson, N. J.
Schneiderman, Jacob, III, '27 (D). 48 Wolcott Street, Dorchester, Mass.
Schreiter, Ehrich Ernest Max, VI, '26 (B.T.E.). Buyer, W. R. Grace & Co., 7 Hanover Square, New York City.
Schwarz, Herman Louis, IV, '22 (B.T.C.). Color Chemist, Sandoz Chemical Works, Inc., 710 Washington Street, New York City.
Scott, Gordon Maxwell, IV, '20 (B.T.C.). Chemist, Holden-Leonard Company, Bennington, Vt.
Shaber, Hyman Jesse, VI, '17 (B.T.E.). (M.B.A., 1922, Harvard University.) With Abraham & Straus, Inc., Brooklyn, N. Y.
Shanahan, James Edward, II, '22 (D). Manager, Hygeia Ice & Coal Company, Amsterdam, N. Y.
Shananquet, Mrs. Lee (Woodies, Ida A.), IIIb, '00 (C). Occupational Therapist, Sunshine Sanatorium, Grand Rapids, Mich.
Shea, Francis James, II, '12 (D). With Corticelli Silk Company, Florence, Mass.
Shea, John Francis, IV, '28 (B.T.C.). Assistant Superintendent of Dyeing, James Lees & Sons, Bridgeport, Pa.
Shedd, Jackson Ambrose, III, '28 (D). Designer, Lincolnfield Mills, Lincoln, Maine.
Shelton, Charles Leopold, VI, '29 (B.T.E.). Development Engineer, Mohawk Carpet Mills, Inc., Amsterdam, N. Y.
Shenker, Nahman, III, '25 (D).
Sidebottom, Leon William, IV, '11 (D). Chemist, Boston Blacking Company, Inc., East Cambridge, Mass.
Sjostrom, Carl Gustof Verner, Jr., III, '17 (D). Head of Waste Department, Cleveland Worsted Mills Company, Cleveland, Ohio.
Slamin, Alfred Francis, I, '26 (D). Research Department, Nashua Manufacturing Company (Suffolk Mills), Lowell, Mass.
Sleeper, Robert Reid, IV, '00 (D). Textile Colorist, Calco Chemical Company, Bound Brook, N. J.
Smith, Albert Adams, I, '99 (D). Deceased.
Smith, Allen Batterman, I, '26 (D). Head of Mill Department, Turner Halsey Company, 74 Leonard Street, New York City.
Smith, Doane White, II, '10 (D). 15 Oakland Street, Natick, Mass.
Smith, Frank Kenfield, II, '24 (D). Research, Belding-Heminway Company, Northampton, Mass.
Smith, Herbert Jeffers, VI, '22 (B.T.E.). Overseer of Ring Spinning, Potter Fine Spinners, Inc., Pawtucket, R. I.
Smith, Ralston Fox, I, '04 (C). Sales Manager, W. H. Warner & Co., 1708 Union Trust Building, Cleveland, Ohio.
Smith, Roger Dennis, II, '27 (D). 131 Portland Street, Haverhill, Mass.
Smith, Stephen Eaton, I, '00 (D). Died May 10, 1926.
Smith, Theophilus Gilman, Jr., IV, '10 (D). Farming, Groton, Mass.
Smith, William Charles, IV, '26 (B.T.C.). Research Associate, American Association of Textile Chemists & Colorists, Bureau of Standards, Washington, D. C.
Snelling, Fred Newman, II, '03 (D). With the American Railway Express Company, Haverhill, Mass.

Sokolsky, Henry, VI, '17 (B.T.E.). Time Study Supervisor, B. F. Sturtevant Company, Hyde Park, Mass.

Somers, Benjamin, II, '25 (D). 128 Pleasant Street, Brookline, Mass.

Southwick, Charles Hudson, IV, '22 (B.T.C.). Boss Dyer, Fairmount Dye Works, Woonsocket, R. I.

Spiegel, Edward, II, '03 (C). 647 West 169th Street, New York City.

Standish, John Carver, IV, '11 (D). Superintendent, Albany Felt Company, Albany, N. Y.

Stanley, John Prince, Jr., IV, '29 (B.T.C.). Chemist, United Piece Dye Works, Lodi, N. J.

Stass, John George, II, '27 (D). Textile Analyst, United States Testing Company, Inc., 316 Hudson Street, New York City.

Steele, Everette Vernon, IV, '24 (B.T.C.). Purchasing Agent, Rohm & Haas Co., Inc., Philadelphia, Pa.

Stephens, Arnold George, I, '29 (D). With The United Shoe Machinery Corporation, Providence, R. I.

Stevens, Dexter, I, '04 (D). Vice-President, Manville-Jenckes Company, Pawtucket, R. I.

Stevens, Raymond Russell, IV, '19 (B.T.C.). Overseer of Dyeing, The Felters Company, Inc., Millbury, Mass.

Stevenson, Murray Reid, III, '03 (C).

Stewart, Arthur Andrew, II, '00 (D). Professor of Textiles; in charge of Finishing Department, Lowell Textile Institute, Lowell, Mass.

Stewart, Walter Lawrence, III, '03 (D).

Stiegler, Harold Winfred, IV, '18 (B.T.C.). (M.S., 1922, Ph.D., 1924, Northwestern University.) Research Work, Cheney Brothers, South Manchester, Conn.

Stohn, Alexander Charles, III, '06 (C). General Superintendent, Carl Stohn, Inc., Hyde Park, Mass.

Stone, Ira Aaron, IV, '09 (D). Vice-President, Royal Manufacturing Company, Charlotte, N. C.

Storer, Francis Everett, II, '07 (D). With Windham County National Bank, Danielson, Conn.

Storey, Alvin Briggs, VI, '28 (B.T.E.). Textile Engineer, Celanese Corporation of America, Amcelle, Md.

Stott, John Smith, III, '28 (D). Assistant Designer, Pacific Mills, Lawrence, Mass.

Stronach, Irving Nichols, IV, '10 (D). Superintendent, Hampton Company, Easthampton, Mass.

Strout, Kenneth Edward, III, '28 (D). Designer, American Mills Company, Waterbury, Conn.

Stursberg, Paul William, II, '07 (D). Died in 1913.

Sturtevant, Albert William, IV, '17 (D). Garage Owner, Sturtevant's Repair Shop, 38 Brookside Street, Lowell, Mass.

Sturtevant, Fred William, IV, '26 (B.T.C.). Chemist, Better Fabrics Testing Bureau, 225 West 34th Street, New York City.

Suhlke, Waldo Eric, IV, '20 (B.T.C.). 240 East Main Street, Meriden, Conn.

Sullivan, John David, VI, '12 (D). With Robert Gair Company, Bradford, Mass.

Sullivan, Lambert William, II, '23 (D). Woonsocket, R. I.

Sullivan, Willard David, II, '23 (D). 39 Loring Street, Lowell, Mass.

Sunbury, Herbert Ellsworth, VI, '18 (B.T.E.). Mill Manager, Asbestos Spinning & Weaving Corporation, Waterford, N. Y.

Sutcliffe, Henry Mundell, II, '25 (D). Overseer, Uxbridge Worsted Company (Granite Mills), Pascoag, R. I.

Sutton, Leslie Emans, I, '17 (D). Superintendent, Anniston Cordage Company, Anniston, Ala.

Swain, Harry LeRoy, Jr., I, '26 (D). Manager, Cotton and Fabric Department, Firestone Tire & Rubber Co., Akron, Ohio.

Swan, Guy Carleton, II, '06 (D). Chemist in charge of Imports, United States Department of Agriculture, 201 Varick Street, New York City.

Swanson, John Harold, I, '28 (D). Designer, Georgia Kincaid Mills, Griffin, Ga.

Sweeney, George Hamilton, II, '24 (D). Salesman, Stein, Moss & Co., 84 Chauncy Street, Boston, Mass.

Sweet, Arthur Dutcher, VI, '21 (B.T.E.). Died January 27, 1927.

Swift, Edward Spooner, S. J., I, '02 (D). Clergyman, Church of the Immaculate Conception, Boston, Mass.

Sylvain, Charles Emile, VI, '13 (D). Resident Engineer, Saco-Lowell Shops, and Textile Engineer for International Machinery Company, Rua S. Pedro, 66, Rio de Janeiro, Brazil.

Syme, James Francis, II, '00 (D). With Mohawk Carpet Mills, Inc., Amsterdam, N. Y.

Symmes, Dean Whiting, IV, '22 (B.T.C.). Salesman and Demonstrator, National Aniline and Chemical Company, 27 Lewis Wharf, Boston, Mass.

Tarpey, Thomas Joseph, IV, '27 (B.T.C.). Chemist, National Aniline and Chemical Company, Buffalo, N. Y.

Tarshis, Elias Aaron, IV, '28 (B.T.C.). Assistant Dyer, Gotham Silk Hosiery Company, Inc., New York City.

Teague, Charles Baird, II, '26 (D). Civil Engineer, Highway Division, Massachusetts Public Works Department, Boston, Mass.

Thaxter, Joseph Blake, Jr., II, '12 (D). Vice-President, Ludlow Sales Corporation, 80 Federal Street, Boston, Mass.

Thomas, Roland Vincent, I, '05 (C).

Thompson, Arthur Robert, Jr, IV, '22 (B.T.C.). Southern Manager, Rohm & Haas Company, Inc., 1109 Independence Building, Charlotte, N. C.

Thompson, Everett Leander, I, '05 (D). Salesman, Gulf Refining Company, Park Square Building, Boston, Mass.

Thompson, Henry James, IV, '00 (D). Dyer, United States Rubber Company, Malden, Mass.

Tilton, Elliott, Thorp, II, '99 (D). Died January, 1917.

Todd, Walter Ernest, III, '23 (D). Superintendent, Stanley Woolen Company, Uxbridge, Mass.

Toepler, Carl, IV, '22 (B.T.C.). Chemist, Bellman Brook Bleachery Company, Fairview, N. J.

Toovey, Sidney Ernest, II, '04 (C). Deceased.

Toshach, Reginald Alexander, II, '11 (D). Assistant Superintendent, M. T. Stevens & Sons Company (Pentucket Mills), Haverhill, Mass.

Toupin, Stephane Frederick, VI, '24 (B.T.E.). Surveyor, Canadian National Railways, Montreal, Canada.

True, William Clifford, II, '22 (D). With Chelsea Fiber Mills, Brooklyn, N. Y.

Tyler, Lauriston Whitcombe, II, '16 (D). Assistant Manager, W. T. Grant Department Stores, 798 Chapel Street, New Haven, Conn.

Valentine, Burnet, VI, '23 (B.T.E.). Merchandise Manager, Pepperell Manufacturing Company, 40 Worth Street, New York City.

Varnum, Arthur Clayton, II, '06 (D). Superintendent, Troy Blanket Mills, Troy, N. H.

Villa, Luis Jorge, IV, '25 (B.T.C.). Automobile Dealer, Hijos de Vicente, B. Villa & Co., Medellin, Colombia, S. A.

Villa, William Horace, VI, '24 (B.T.E.). Textile Engineer, Compania Colombiana de Tejidos, Medellin, Colombia, S. A.

Villeneuve, Maurice Arthur, II, '26 (D). With Killingly Worsted Mills, Danielson, Conn.

Vincent, William Henry, III, '26 (D).

Walen, Ernest Dean, VI, '14 (B.T.E.). Agent (Worsted Division), Pacific Mills, Lawrence, Mass.

Walker, Alfred Schuyler, II, '11 (D). 67 Park Avenue, Saranac Lake, N. Y.

Walker, Anna Gertrude, IIIb, '03 (C). See Pradel, Mrs. Alois J.

Walker, Raymond Scott, II, '23 (D). Foreman, Mohawk Carpet Company, Amsterdam, N. Y.

Wang, Chen, IV, '23 (B.T.C.).

Wang, Cho, VI, '23 (B.T.E.).

Wang, Tung Chuan, VI, '23 (B.T.E.).

Wang, Yung Chi, II, '21 (D). Factory Manager, Ching Yuen Silk Weaving Factory, Shanghai, China.

Ward, George Chester, IV, '28 (B.T.C.). Textile Chemist, Celanese Corporation of America, Cumberland, Md.

Warren, E. Maybelle, IV, '28 (B.T.C.). Billerica, Mass.

Warren, Philip Hamilton, II, '05 (D). Superintendent, Hopeville Manufacturing Company, Worcester, Mass.

Washburn, John Milton, Jr., IV, '21 (B.T.C.). Assistant Superintendent, Bailey's Cleansers and Dyers, Inc., Watertown, Mass.

Watson, William, III, '11 (D). Real Estate, Frank E. Watson, 50–54 Merrimack Street, Haverhill, Mass.

Webb, Frank Herbert, IV, '04 (D). Died March 20, 1919.

Webber, Arthur Hammond, IV, '01 (D). Chemist and Demonstrator, Melville Color Company, 93 High Street, Boston, Mass.

Webster, Joseph Albert, VI, '23 (B.T.E.). Assistant Superintendent, Aberfoyle Manufacturing Company, Chester, Pa.

Weinstein, Edward Joseph, VI, '25 (B.T.E.). Harrison Hardware Company, Harrison, N. Y.

Weinz, William Elliot, IV, '08 (D). Died Feb. 9, 1928.

Wells, Ai Edwin, VI, '20 (B.T.E.). Assistant Professor, Mechanical Engineering, Lowell Textile Institute, Lowell, Mass.

Westaway, John Chester, VI, '28 (B.T.E.). Salesman, W. J. Westaway Company, Ltd., 455 Craig Street, West, Montreal, Que.

Westbrooke, Clayton Collington, IV, '29 (B.T.C.). Assistant Chemist, Bigelow-Sanford Carpet Company, Thompsonville, Conn.

Wetherbee, Francis Putney, I, '28 (D). Assistant Superintendent, Maverick Mills, East Boston, Mass.

Wheaton, Walter Francis, VI, '23 (B.T.E.). Sales Promotion, Bliss, Fabyan & Co., 32–36 Thomas Street, New York City.

Wheelock, Stanley Herbert, II, '05 (D). President and Treasurer, Stanley Woolen Company, Uxbridge, Mass.

Whitcomb, Roscoe Myron, IV, '10 (D). Pharmacist, R. M. Whitcomb, Ashland, N. H.

White, Royal Phillip, II, '04 (D). Agent, Stirling Mills, Lowell, Mass.

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Wiech, Raymond Edward, IV, '29 (B.T.C.). With Waldrich Bleachery, Delawanna, N. J.

Wightman, William Henry, IV, '06 (D). Salesman, Ciba Company, Inc., 157 Federal Street, Boston, Mass.

Wilcox, Leonard Edward, VI, '24 (B.T.E.). Assistant Manager, W. T. Grant Company, 455 Seventh Avenue, New York City.

Williamson, Douglas Franklin, I, '22 (D). Superintendent, American Net and Twine Company, Blue Mountain, Ala.

Wilman, Rodney Bernhardt, II, '25 (D). Head Designer, Amoskeag Mills, Manchester, N. H.

Wilson, John Sigmund, II, '03 (D). Deceased.

Wilson, Walter Ernest Hudson, I, '04 (C). Deceased.

Wing, Charles True, III, '02 (D). Paymaster, Merrimack Woolen Corporation, Dracut, Mass.

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Wingate, William Henry, IV, '08 (D). With Lyons Piece Dye Works, Paterson, N. J.

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Wood, Ernest Hadley, S.B., IV, '11 (D).

Wood, Herbert Charles, I, '06 (D). Died May 14, 1929.

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Woodies, Ida Alberta, IIIb, '00 (C). See Shananquet, Mrs. Lee.

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THE RELATION OF PHYSICS TO THE TEXTILE INDUSTRY*

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The breadth and scope of Physics is comprehended fully by those who are familiar with the numerous principles suggested to the mind by the mention of those branches of Physics commonly termed kinematics, dynamics, mechanics of solids, mechanics of liquids, mechanics of gases, heat, light, sound and electricity. It is recognized as a fundamental, underlying, basic and essential subject to be pursued by all who expect to enter upon any branch of scientific work. It is presumed that the reader is familiar with the scope of a college course in Physics, but not so well acquainted with the magnitude of the textile industry and the nature of its processes. The extent, importance and character of both must be grasped before the relation of Physics to the textile industry can be fully appreciated.

The standing of the textile industry relative to the sixteen major ones of this country can be brought out clearly by the use of some figures presented by the National Industrial Conference Board. These indicate that the industry employs approximately 1,700,000 wage earners and in this respect it stands in first position. It pays wages which amount annually to $1, 700,000,000 and here again it ranks in first place. The value of the raw materials which it consumes amounts in the course of a year to $5,400,000,000, a fact which places it in second rank, and the value of its finished product is expressed by $9,100,000,000, again placing it in second position. The comprehension of the magnitude of these numerical quantities may serve to give an idea of the size and scope of that industry into which the Lowell Textile Institute is sending its technically trained graduates.

The various textile fibres which the different branches of this industry utilize are exceedingly interesting, as are also the materials which are made from them and their uses. Wool, an animal fibre, largely enters into the manufacture of men's and women's dress goods, overcoatings, sweaters, robes, upholsteries, various kinds of felts, carpets, rugs, blankets, and underwear. Silk, another animal fibre, finds its most important use in the manufacture of dress goods, underwear, hosiery, linings and ornamental fabrics such as draperies, tapestries, scarfs, etc. In the industrial field it is used for the insulation of electrical wire, for the construction of gas bags for dirigibles, and a certain kind of silk cloth is used as one of the finest sieves. Rayon, the artificial silk fibre of which so much is heard at present, is being used for practically all the same purposes enumerated above for silk, and it is a matter of common knowledge that the production and use of this fibre has grown enormously in the past five years. Although its physical properties in some respects are not quite the same as those of silk, there is no doubt but that the chemical processes involved in its production will in time be so changed and improved that the artificial product will finally be equal and possibly even better than the fibre which it is replacing.

Cotton, a vegetable fibre, is one the consumption of which exceeds that of any other fibre named. It enters not only into the construction of very fine dress goods but it is the most important commercial fibre for industrial use. It is used for example alone or in combination with other fibres for ginghams, shirtings, sateens and many dress goods purposes, for underwear and hosiery, for upholstery and ornamental material, for blankets, sheetings,

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*This article is based upon a paper presented by the author before a recent meeting of the Eastern Association of Physics Teachers.

towels, spreads, awnings and numerous other household purposes. For industrial purposes it is the basis of the so-called mechanical fabrics, hose and belting ducks, canvases, tire cords and fabrics, artificial leather, airplane wing fabric, balloon cloth and is used in many other places and ways where the strength of a textile fabric is an important consideration.

In addition to the important fibres just mentioned, there are several others. There are the vegetable fibres known as ramie, hemp, jute, and flax from which are manufactured numerous kinds and grades of ropes, twines, burlaps, linens, carpet yarns, etc. Asbestos, a mineral fibre, surprising as it may seem, is spun into yarn and woven into fabrics in much the same manner as are the other fibres. The safety of automobile travel in a large part depends upon brake band linings made of asbestos cloth.

This enumeration of the various kinds and uses of textile fabrics does not pretend to be complete by any means but is given in the hope that it may more forcibly impress upon the mind of the reader the extent, magnitude and scope of this industry which is called Textile. The average person, does not fully realize the manifold uses of textile fibres, nor his everyday dependence upon them.

The intricate problems involved in the manufacture of textile fibres into yarn and cloth have been solved in an intensely interesting manner as a study of textile machinery will clearly indicate. The nature of these problems, to the solution of which Physics has contributed in large part, can be understood better when the dimensions of these raw materials are visualized. As a yard-stick for comparative purposes, take the size of a human hair. It has an average diameter of about .00332". Cotton fibres have a diameter varying from approximately 1/4 to 1/5 of that of a hair and their lengths range from approximately $\frac{3}{4}$ of an inch to $1\frac{1}{4}$ inches. The diameter of woolen fibres is about 1/3 to 1/6 of that of the human hair and their lengths vary from about 2 inches to 5 inches. The length of a silk fibre is practically continuous and its diameter ranges from $\frac{1}{2}$ to $\frac{1}{8}$ of that of our yardstick, and rayon is now being produced in a form practically as fine as that of silk. Such is the character of the raw materials with which the textile manufacturing processes start.

From the original tangled mass of fibres there is produced finally an even thin strand called roving. This roving consists of fibres which have been cleaned, parallelized and which are quite uniformly distributed throughout its length and cross-section. It has no tensile strength because it has no twist. The last step in the production of yarn consists in the drawing down of this roving to its proper size and then giving it its final twist. This operation is known as spinning and is performed in a spinning frame or by a mule.

Cloth is produced from yarn by means of the loom. The essential parts by which the interlacing of the threads is accomplished are the harnesses and top rolls, the lay, shuttle, and picker stick. From these two processes, spinning and weaving in particular, can be drawn many applications of Physics to textile manufacturing.

There are other textile processes of which mention should be made; knitting, that process by which a single yarn instead of many is employed to form fabrics such as hosiery and knit underwear; designing, that process which has to do with the choice of pattern, kind of weave and selection of color combination which will make the fabric attractive or useful to the buyer; bleaching, that process through which all white fabrics must be put to remove the original grey color of the fibre; dyeing, that process which colors the fibres when they are in any one of the following forms, raw stock, yarn, chain or cloth and lastly, finishing, that process which gives cloth its final appearance, luster, thickness, smoothness or roughness, soft or hard feel, in fact, that process which makes the fabric finally ready for the consumer.

What are some of the applications of Physics to these processes? No attempt is made to enumerate all of them for space does not permit; in fact, not in every case have the commonest illustrations been selected because they are so self-evident, but rather some of the more unusual applications. One

would naturally expect that the principles of kinematics, dynamics and mechanics would find wide application in these processes as it does in all others where machinery is used. Unlike some kinds of machinery, for example those used in the working of metals, textile machinery design is more a question of the application of motion of the right kind and properly timed than of large forces. Even a casual inspection of a spinning frame or loom shows they are not heavily constructed, indicating that the forces involved can not be very great.

Uniform Linear Motion

The equations expressing the relationships in this sort of motion find very wide application. Yarn is delivered from the front rolls of a spinning frame at a uniform rate and the amount delivered in a given length of time is a measure of its productivity. The production calculations of most of our textile machinery involve the principles of uniform linear velocity.

Uniform Angular Velocity

The same comments apply to this sort of motion for it is concerned with the revolutions per minute of driving pulleys, of gears, of delivery rolls and hence closely related to the production of the machine.

Acceleration

A thorough understanding of the derivative relationship between acceleration, space and velocity, namely that

$$\text{Acceleration} = \frac{d_2s}{dt^2} = \frac{dv}{dt}$$

is important especially where motion is variable. No analysis of the motion of the lay of the loom would be complete without a determination of its acceleration at all points of its path. Such a determination is a necessary preliminary to the computation of the forces required to accelerate and retard it.

Harmonic Motion

The characteristic of harmonic motion, namely that it starts gradually and ends gradually, makes it exceedingly useful in the design of cams. The movement of the harnesses in a loom is accomplished by a cam, a part of whose outline gives harmonic motion to the harnesses. The guide in the French drawing box is operated by a slotted crosshead. Those familiar with such a mechanism know that it gives pure harmonic motion.

Gravity Motion

The uniformly accelerated character of this motion is particularly adapted for setting objects into motion from a state of rest. In a loom the motion of the picker stick is such that it gives uniformly accelerated motion to the shuttle as it starts on its path across the lay.

Work

An analysis of the work done during the spinning leads to two conclusions. A certain amount of work is usefully employed in twisting the fibres around each other, thereby compacting the yarn and giving it its strength. A larger portion of the work supplied is lost in frictional resistances and windage loss at the balloon.

Horse-power

This topic is always an important one whenever computations are to be made of the size of belts or motors which are necessary to drive textile machinery.

Energy

The passage of the shuttle across the lay of the loom affords an interesting study on the relation between force and energy. Starting from rest the shuttle must receive during the very short time in which the picker stick is in contact

with it, sufficient energy and velocity to travel across the lay. The time of its passage across the lay is exceedingly short being only a fraction of a second in the ordinary case. The resistances which it must overcome are largely the friction which is opposed to its motion and the drag of the filling thread which it is leaving behind. Provision must be made for absorbing the kinetic energy which it has as it enters the box towards which it is going.

Mechanical Efficiency

The ability of a machine to transform the largest proportion of the work which is delivered to it into useful form is always taken as an important measure of its value and effectiveness. It is always the aim of designers to produce machines of the highest efficiency. In modern textile machinery, there is found therefor, an increasing use of ball and roller bearings for this very purpose since it substitutes rolling friction for sliding friction.

Friction

Friction is commonly thought of as a necessary evil where machinery is concerned but analysis shows that it serves many useful purposes. Were it not for the friction which is developed by twisting the fibres around themselves to form a yarn, the strand would have no strength. This is well illustrated by the ease with which the strand of roving, which has very little twist, is broken. In like manner the interlacing and intertwining of yarns to form cloth gives added strength to the fabric because of the friction developed between the strands. Friction is used to regulate the drag on bobbins in worsted spinning, and is absolutely necessary in the drafting or drawing out processes in all spinning. On the other hand, wool fibres are lubricated with an emulsion of olive oil and water to reduce the friction between them.

Triangle and Parallelorgram of Forces and Motions.

These invaluable principles for compounding or resolving forces or motions find a great many applications, for example, in determining the pivot reactions of bent levers.

Pendulum

The principle of the pendulum is commonly employed in the design of machines for determining the strength of textile materials. The lay of the loom furnishes an interesting illustration of an inverted and controlled pendulum. Experimentally it is possible to determine the length of its equivalent simple pendulum, the location of its center of gravity, and hence to compute its radius of gyration and moment of inertia. Such determinations are incident and preliminary to the computation of the force required to accelerate the lay and consequently the forces which thereby act in the frame of the machine, some of which are transmitted to the floor.

Mechanical Principles

Mechanical principles find wide and varied uses in textile machinery. *Levers*, simple and compound, furnish a simple method for the weighting of rolls and many other uses. In making exact calculations their weights and centers of gravity must be determined. The principle of the *wheel and axle* is illustrated by the harness top rolls in a loom. Wherever ropes, bands or chains are used to transmit motion or force, as in a mule, we shall find some of the principles of *simple pulley blocks* involved. The principle of the *inclined plane* is employed to keep rolls in a given position by means of gravity. No machine can be constructed without employing the principle of the *screw* for purposes of fastening or for adjusting the position of parts with great nicety and exactness. Screws may be employed, as in the gill box, to give motion of translation to the fallers.

Heat

The use of heat in the generation of steam and the development of power through its expansion in engine or turbine is so well known as to require no further comment. Heat is commonly employed in the processes of dyeing

and finishing for heating mixtures of textile fabrics with dyestuffs, chemicals, soap solutions or other finishing materials. Technical studies of these processes would involve a knowledge of the water equivalents of materials and the temperature of mixtures.

A detailed study of the use of heat for drying purposes will present many complex problems and involve a knowledge and understanding of the following; the conduction of the heat in the steam through the pipe to the air, its transmission by convection from air to the water in the fabric, the evaporation of this water into air, the absorptive capacity of the air, the specific heats and rates of thermal conductivity of starches, glues and the textile materials themselves, the insulation of the walls of the dryer, and losses by radiation from it.

The heat conductivity of blankets, felts, and all wearing apparel is at once recognized as an important and interesting physical property. Its measurement is merely an application of the principles of calorimetry with which you are all familiar.

The physicist usually discusses the question of absolute humidity and relative humidity under the general topic of heat. The moisture content of the air is a matter of great importance to the textile man and the discussion of it is reserved until later.

Electricity

The widespread use of electricity for light and power is such an obvious application that more obscure ones may be more interesting. Some textile machines are equipped with electrical stop motions, devices which act to stop the machine as soon as a thread or a yarn breaks. In this connection it is common to find magnets employed. Static electricity is an undesirable visitor in the operations of carding and weaving, particularly the weaving of silks and rayons. It is overcome by the use of neutralizers or by maintaining proper moisture conditions in the air.

Even oscillatory circuits may lend their aid to the study of the physical properties of textile materials. In our own laboratory experimentation is in progress in the hope of obtaining a sensitive instrument for measuring the variation in density of textile materials and of extending it to the measurement of their moisture content.

Light

Under this heading comes its familiar application to color, and to those color combinations which make so many of our modern textile fabrics exceedingly attractive. To the dyer, the matching of colors is exceedingly important as well as a study of their fastness to light. The problems of color matching and color measurement have led to the development of tinometers and colorimeters. The luster of textile materials and its measurement presents a somewhat similar problem and studies are in progress at the present time in the laboratories of the Textile Engineering Department of the Lowell Textile Institute in the endeavor to find a solution to it.

Much space could be given to the discussion of the part played by that most important physical instrument, the microscope, in the recognition of fibres and fabrics and a study of their physical characteristics. The use of the spectrophotometer for the identification of dyestuffs and for the determination of their concentration and purity by spectral absorption is an interesting application of the principle of the spectroscope. The employment of polarized light and X-rays for the study of fibres and the determination of the character of their structure is finding a wider and wider application.

Vapor Pressure

The outstandng characteristic of all textile fibres is that they are hygroscopic. They have the property of absorbing moisture from the air and appropriating it to themselves. The percentage absorbed may vary anywhere from nothing to fifteen or twenty percent according to the nature of the fibre and the atmospheric conditions. Whether a material will absorb moisture or

give it off is merely dependent upon the relative magnitudes of vapor pressure of the air in the fibres and the vapor pressure of the water in the air.

The presence of this moisture in a fabric, one measure of which is called its regain, is of great practical importance to buyers and sellers because it affects the weight. Since most textile fabrics are bought and sold on a weight basis, it is very vital that the buyer should know how much cotton or wool he is obtaining in his cloth and how much water he is paying for. This moisture likewise affects the strength of a fabric causing it to vary over a wide range according to the kind of material and the character and closeness of weave.

Absolute and Relative Humidity

Recognition of regain and its effect upon the physical properties of fibres has necessitated the standardization of atmospheric conditions in testing laboratories. A standard atmosphere, therefore, is one in which the temperature is 70° Fahrenheit and which contains 65% relative humidity. To understand the relations between a standard atmosphere and one which is not, involves an understanding of saturated and unsaturated vapors, vapor pressure, dew point, absolute humidity and relative humidity. It must suppose a knowledge of the common means of measuring relative humidity, for example, the use of various forms of hygrometers and psychrometers.

Physical Properties of Textiles

The physical properties referred to are tensile strength, elastic stretch, crimp, twist, thickness, evenness, abrasive resistance, tear resistance, resiliency, porosity, absorptibility, water proofness, and regain. For the determination of these properties various machines and methods have been devised, some of which are of a precision character, and some are not. In any event physical principles find application in all of them, and in some cases standard physics laboratory equipment is used.

Thus Physics has made its contribution to the progress of the textile industry and the subject, therefore, finds an important place in the training of a Textile Engineer.

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DEPARTMENT
OF
LOWELL EVENING TEXTILE SCHOOL

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LOWELL EVENING TEXTILE SCHOOL.

By Act of the Legislature of 1928, the name of the Lowell Textile School was changed to Lowell Textile Institute, and the evening classes are organized and are to be hereafter operated as a department of the Institute to be known as the Lowell Evening Textile School.

CALENDAR.

1930.

September 25, Thursday	Registration.
October 2, Thursday	Registration.
October 6, Monday	Opening of evening school.
November 27, Thursday November 28, Friday	Thanksgiving recess. No classes.
December 19, Friday	End of first term.

1931.

January 5, Monday	Opening of second term.
March 6, Friday	Closing of evening school.
April 8, Tuesday	Graduation.

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EVENING CLASSES.

GENERAL INFORMATION

Entrance Requirements.

All applicants to the evening classes must understand the English language and simple arithmetic. Those who are graduates of a grammar or high school are admitted upon certificate. Those who cannot present such a certificate are required to take examination in the subjects of English and arithmetic. In the examination in English a short composition must be written on a given theme, and a certain amount must be written from dictation. In the examination in arithmetic the applicant must show suitable proficiency in addition, subtraction, multiplication, division, common and decimal fractions, percentage, ratio and proportion. Opportunity to register or to take these examinations is offered each year, generally on the Thursday evenings of the two weeks previous to the opening of the evening school.

Registration.

Before entering the class a student must fill out an attendance card, which can be obtained at the office or from the instructors in the various departments.

Any student who has filed an attendance card and who wishes to change his course must notify the office before making the change.

Sessions.

The evening classes commence the first Monday of October and continue for twenty weeks. The school is open on four evenings each week during the period mentioned, except when the school is closed for holiday recesses.

Supplies.

Students must provide their own books, stationery, tools, etc., and pay for any breakage or damage that they cause.

Students' supplies will be sold from the co-operative store every evening school night from 6.45 to 8.15 P.M.

Fees and Deposits.

All evening courses are free to residents of Lowell. To those outside of Lowell the fee is $10 per year for *each course of two nights per week.* Students taking two courses or attending courses requiring more than two nights per week are required to pay $15 per year for three nights and $20 for four nights.

All fees and deposits must be paid in advance.

All students, whether from Lowell or not, taking Course 411, Chemistry and Dyeing Department, are required to make a deposit at the commencement of the course—$5 for first-year students, and $10 for second-year students. A deposit of $10 will be required of all students taking Course 412, 413 or 414. This is to cover the cost of laboratory breakages, chemicals, apparatus, etc., and at the end of the year any unexpended balance is returned, or an extra charge made for the excess breakage.

Every student who takes the chemistry and dyeing course must check up his desk with the instructor of that department when he leaves the school. Any student not doing so will be charged 50 cents.

All students taking Machine-Shop Practice will be required to make a deposit of $5. Any unexpended balance remaining at the end of the year will be returned to the student.

Report of Standing.

A report of standing covering the year's work is sent to all students who attend the entire year and take the necessary examinations.

Certificates.

The courses of the evening school are varied and arranged to meet the special needs of those engaged in the industry. They vary in length from one to four years, and at the completion of each course the certificate of the school is awarded, provided, however, that the student has been in attendance in the course during the year for which the certificate is granted.

GENERAL EVENING COURSES.

The object of these courses is to give young men of ambition an opportunity to obtain instruction in all the branches of science that are allied with their daily work. For example, one who is employed as a weaver in a textile mill may, by means of the course in manufacturing, obtain knowledge of the manufacture of yarn, the production of a design, and the methods of finishing a fabric, as well as the manner of its weaving or knitting. In like manner the dyer may augment his knowledge of the chemicals and materials he is daily handling. The engineer and machinist may acquire a knowledge of the mathematics, science of mechanics, electricity and drawing that underlie all the work of an engineer.

It is recognized that the interests of such students lie in a particular field of industry, and these courses are designed to bear directly upon the special line, and supplement, as far as possible, the practical work in which the student is engaged during the day.

In a word, any man having a common school education and the ambition to advance in his line may now secure a broad and comprehensive training in the subjects which will be of vital importance to him in obtaining the goal of his ideal.

A description of all courses follows.

COTTON DEPARTMENT.

110. Cotton Yarns — 3 Years.

The *first year* work in cotton yarn manufacture consists of a study of cotton and its preparation for market, followed by a study of opening, picking, carding and combing. This work consists of lectures on these operations combined with problems that are peculiar to each operation such as the drafts used and the production of each process as well as the amounts of waste made. Special consideration is given to the adjustment and care of these machines and some laboratory demonstration is used to show the manner of adjusting machines for the purpose of controlling the weight of the product, the amount of work done in a day and the control of waste.

Two evenings per week.

COTTON. — Before taking up the details of manufacturing cotton into yarn, a careful study of its physical characteristics is made. The geographical distribution of the areas producing commercial cottons is explained and the characteristics of the cottons produced in each are studied. A general explanation of the cultivation and harvesting of cotton is made, especially emphasizing the effect of agricultural factors on the cotton fiber and how these may serve to complicate manufacturing problems.

The ginning of cotton is considered, showing the yield of lint, the uses of cotton seed and the various types of gins and which cottons are commonly ginned on each.

The intricate system of buying and selling cotton is studied to illustrate the problems a mill may meet in procuring cotton. In this connection, special emphasis is placed on the classification of cottons by staple and by grade.

Opening and Picking. — Instruction in the preliminary operation of opening and picking covers the mechanical construction of the machines, their parts and adjustments, as fully as the manufacturing results accomplished by the machines. This includes such construction details as evener, lap measuring and safety stop motions, grids, cleaning trunks and beaters, also operation details which involve the adjustment for waste, drafts and character of laps. Some time is devoted to mixing in its various phases, showing in addition to improvement in uniformity of the product, how cottons are mixed to obtain definite average prices and how different percentages of color may be obtained by mixing, especially on the pickers.

Carding. — The process of carding is considered one of the most important, and proper time is devoted to the construction and operation of cards that the student may be familiar with the various parts of the card and the function and design of each. The construction and application of card clothing, as well as the methods of grinding, form a part of the work. Some time is given to a discussion of the waste made in carding, the regulation of the amounts of each made and the calculation of the percentages. New and special attachments for various purposes are brought to the attention of the class, illustrating possible ways of improving carding conditions.

Combing. — The preparation of card sliver for combing by means of the sliver lapper and ribbon lapper, is thoroughly considered. The combing operation itself is studied in considerable detail, emphasizing the general object and operations in combing and the specific means employed by various types of combs in performing the operations. The calculations in this connection involve the drafts and doublings necessary to produce the proper lap for the comb, the proper comb drafts, and the determination of the per cent of noil produced.

The *second year* work includes a study of the drawing and roving processes and the calculations that accompany these operations. It consists of lectures on the machines and demonstration of their adjustment, showing roll setting, draft and twist control, builder adjustment, spacing coils on the bobbin, and tension control.

One evening per week.

Drawing. — Under this head is taken up the theory of doublings and their effect upon the quality of roving and yarn. Like previous and subsequent processes the machine construction forms an important part of the work. Proper stress is paid to such subjects as stop motions, drawing rolls and their covering, clearers and evener motions.

Roving Process. — Under this head are studied the various machines known as the slubber, intermediate, fine and jack fly frames. Each of the various motions of these complicated machines is treated separately and then the group is taken as a unit, tying each operation in with the others. Particular attention is paid to the subjects of lay and tension because of their importance in producing perfect roving. The calculations in this subject involve draft, twist, lay and tension with particular attention to the derivation of constants and their use.

During the *third year* the time is devoted to a study of ring and mule spinning, spooling, winding, twisting and reeling, instruction being given by means of lectures and demonstrations. There is also some work done on the combing machine, particularly in the nature of its adjustment. In addition to these subjects, some time is spent on planning the organization of a cotton mill with a view to showing drafts, speeds, productions and number of machines of each kind necessary for the production of a given amount of a certain yarn.

Two evenings per week.

Ring Spinning. — The consideration of spinning yarn by the ring frame method involves a knowledge of the uses to which the yarn is to be

put and subsequent methods of handling, that proper roving may be selected, suitable amounts of draft and twist provided, correct size of rings and travelers selected, and building motions suitably adjusted. Yarn defects are studied with reference to the cause and remedy, necessitating references to many of the earlier operations.

Mule Spinning. — This method of spinning is very different from that of the ring frame, and the mechanical details are more complicated. The student is furnished with a new means of producing yarns, and can compare the relative advantages of each method. A thorough understanding of mule spinning is perhaps more a study of mechanical motions and their functions. This results almost invariably in assisting the student to understand previous processes and machines better because of his work on the mule. It is the object to make clear to the student's mind the principles underlying the construction and operation of the parts that control the drawing, twisting, backing off and winding, together with such special motions and devices as are used upon the modern mule.

Spooling and Winding. — The discussions under this head cover the treatment of single yarns, ring or mule spun, in preparation for twisting, comparing the relative merits of spooling with multiple winding on tubes, and beaming for special twisters. Winders are also considered as a means of preparing yarn packages for sale yarns.

Twisting. — Because of the similarity to ring spinning, the emphasis is more on the manufacturing part of the work, although there are a few peculiar features of a mechanical nature. The twisting of various regular ply yarns, the making of numerous fancy yarns and the principles underlying the production of unlimited patterns is taken up here. The use of special twisters and other apparatus for cords and ropes is considered at this point.

112. Cotton Manufacturing — 4 Years.

The Cotton Manufacturing course is designed to give a student a broad knowledge of the manufacture of cotton cloth. To do this he is required to spend three years in the department of cotton yarns, studying cotton and its conversion into yarn. A student taking this course also spends two years in weaving, one on plain and one on dobby weaving. Three years are spent in a study of the art of designing a fabric and the analysis of fabric already constructed. One year is spent in a study of the processes involved in finishing cotton fabrics. For detailed description, see subjects under Yarns, Weaving, Designing and Finishing.

WOOLEN AND WORSTED DEPARTMENT.

210. Worsted Yarns — 2 Years.

During the *first year* instruction consists of a lecture course on the various kinds of wool fibers, trade terms, sorting, scouring, carbonizing, etc., also a course in carding and the calculations involved in the mechanism of the machines, and a course covering gilling and combing and the processes of top making.

Raw Materials. — A study of raw materials which enter into the manufacture of woolen or worsted yarns, or are made into yarns by processes similar to those employed in the manufacture of woolen and worsted yarns, would include silk, mohair, alpaca, vicuna, cashmere, camel's hair and cotton. In connection with these are considered shoddy, noils and extracts.

Wool Sorting. — Familiarity with the various grades and kinds of wool is obtained by lecture. The various characteristics and properties are explained, as are also trade terms, such as picklock, XXX, XX, ½-blood, ⅜-blood, ¼-blood, delaine, braid, etc. Some skill is acquired in the estimation of shrinkage and in judging the spinning qualities.

Wool Scouring. — The object of scouring and the methods employed are explained, and this involves the consideration of soaps and chemicals

used in washing; also the waste products and their utilization. A demonstration of a commercial quantity of wool is scoured by machines that are made similar in operation to regular commercial machines. A study is made of the effect of the hardness of water upon soap. At the same time the use of driers, their operation and regulation, is taken up, and the methods of carbonizing wool, noils, burr waste, rags, etc., are studied and explained.

CARDING. — The different systems of carding wool, depending on whether it is to be made into woolen or worsted yarns, are fully explained, as is also the construction, setting and operation of cards. A part of this work consists of a study of card clothing, its construction, application and grinding.

TOP MAKING AND COMBING. — This branch takes up, besides the carding of the wool on a worsted card, the preparing processes, backwashing, also gilling of the stock before and after combing. The construction of the gill boxes and combs is studied by lectures. Later, quantities of stock are made into top and then into yarn.

Three evenings per week.

The *second year* is devoted to detail study of the English and French systems of worsted yarn manufacture.

The Noble, Lister and French combs are studied, and the various calculations to determine draft, noiling, productions, etc., are made.

DRAWING AND SPINNING. — The equipment in the laboratory offers opportunity to make worsted yarn by either the Bradford or open drawing system or by the French system. The process includes the various machines in the successive steps of making Bradford spun yarn, and the functions of the different machines are studied. In the latter, or French system, the stock is run through the drawing machines, and the roving spun into yarn on the worsted mule. The same method of studying the mechanism and operations of these machines is followed as in the case of previous methods of instruction. The student by pursuing this course can compare the different methods of yarn manufacture and note the results of each.

With the instruction in spinning by the Bradford system is given work on the twisters and the effects that may be produced.

Three evenings per week.

211. Woolen Yarns — 2 Years.

During the *first year* instruction consists of a lecture course on the various kinds of wool fibres, trade terms, sorting, scouring, carbonizing, etc., also of a course on carding, and the calculations involved in the mechanism of the machines.

Two evenings per week.

The *second year* continues the instruction on carding and then takes up a course on the mule and woolen yarn spinning.

BURR PICKING, MIXING, OILS AND EMULSIONS. — The use of burr pickers in cleaning wool and the use of mixing pickers in making color blends is covered by lecture and demonstration. Under the subject of oils and emulsions are taken up the characteristics of various oils and the means employed to test them.

WOOLEN MULE. — The student studies thoroughly the operation of the mule as a whole, and acquaints himself with the various principal mechanisms, as, for example, the backing off and winding motions, the quadrant, builder-rail, faller regulation, etc.

Two evenings per week.

214. Woolen Manufacturing — 4 Years.

215. Worsted Manufacturing: Bradford System — 4 Years.

216. Worsted Manufacturing: French System — 4 Years.

These courses are arranged to give those engaged in the manufacture of woolens and worsteds instruction in the various branches of the work. It embraces a study of wools and allied fibres and the manner of manipulating from fibers to finished fabric, including all processes of yarn manufacturing, weaving, designing and finishing. The instruction given in these three courses is the same throughout the four years with the exception of that given in yarns.

During the *first year* lectures are given on wool fibres and the preliminary processes of their conversion into yarns, calculations of the mechanism of the machines and elementary instruction in cloth designing and analysis.

During the *second year*, students selecting the Woolen Manufacturing Course follow a course in carding and mule spinning and continue the first year work in design and cloth analysis. Students taking either of the Worsted Manufacturing courses continue their work in yarns by studying gilling, combing and the processes of top making. More time is given this year to design and cloth analysis.

In the *third year* students continue their instruction in yarn manufacture, design and cloth analysis, and add the subject of weaving to the course.

During the *fourth year* instruction is given in weaving and finishing.

TEXTILE DESIGN AND WEAVING DEPARTMENT.

311. Cotton Design — 3 Years.

During the *first year* instruction is given in elementary designing, starting with all the foundation weaves which may be used in fabrics such as the plain weave, rib weaves, basket weaves, twill weaves, satin weaves, granite weaves, etc. Combination and derivative weaves are made up from the aforesaid weaves. Fancy and figured weaves, in most cases originated by the student, are produced. Color effects, which are so essential in fabrics, obtainable from the different weaves, as stated above, in which the color arrangement of warp and filling create the pattern, are thoroughly considered. Not only the designing, but also harness drafting and the making of dobby chains for any type of weave is taken up.

Cloth analysis is considered in conjunction with designing, as a designer must know the kind of fabric he is designing, what material and what size of yarns are to be used, and how heavy and costly the cloth is to be. The various topics discussed are the sizes or counts of yarns made from all kinds of fibers, such as cotton, woolen, worsted, silk, rayon, jute and yarns of other vegetable fibers. Their relative length to the pound is determined in the single two or more ply, mixed yarns, novelty yarns and fancy yarns, in the American or English system. The same is given in the metric system. Problems involving the take-up of yarns in the weaving and finishing process are given. Samples of cloth are picked apart to determine their weaves and general construction.

Two evenings per week.

In the *second year* cloth analysis and design are combined in lecture and practice, starting with plain and leading into the more fancy cotton dobby fabrics. A great variety of samples of cloth are used in class work to determine ends and picks per inch, shrinkage in warp and filling, and the number of reed and reed widths necessary for eventual reconstruction. The yarn numbers of warp and filling are determined by aid of fine balances. The amount of warp and filling necessary for a piece of goods is calculated and the weight of a whole piece as well as the number of yards per pound are determined.

Two evenings per week.

In the *third year* more elaborate cloths are considered, both in designing and analysis, cloths in which extra warp or extra filling, or both, are used. Warp backed, filling backed, double, triple or more plied fabrics are taken

up, such as marseilles, quiltings, piqué, suspenders, narrow webbings, velveteens, fancy velveteens, velvets, corduroys, Bedford cords, plushes, leno, in fact, anything a student may suggest which might help him in his work.

Two evenings per week.

312. **Woolen and Worsted Design — 3 Years.**

This course covers the design and analysis of standard woolen and worsted fabrics and is intended for those who wish to specialize in this branch of textile fabric manufacture. Special and fancy fabrics are studied to the extent that time will permit.

During the *first year* instruction is given in the subject of classification of fabrics, use of point or design paper, plain fabrics, intersection, twills and their derivation, sateen, basket and rib weaves, checks and stripes, fancy weaves, including figured and colored effects; producing chain and draw from design, and *vice versa;* extending and extracting weaves.

The analysis of samples is taken up in a systematic manner, illustrating the various cloth constructions for the purpose of determining the design of the weaves and the amount and kind of yarns used, and forms the basis of calculation in the cost of reproducing any style of goods. The various topics discussed are reeds and setts; relation and determination of counts of cotton, woolen, worsted, silk and yarns made from the great variety of vegetable fibers; grading of yarns, folded, ply, novelty and fancy yarns; application of the metric system to yarn calculation; problems involving take-up, average counts, determination of counts of yarn, and weight of yarn required to produce a given fabric.

Two evenings per week.

During the *second year* instruction is given in cotton warp goods, blankets, bath robes, filling reversible, extra warp and filling backs, figured effects produced by extra warp and filling, double cloths and plaid backs.

The analysis work follows as closely as possible the type of fabrics taken up in the designing and the reconstruction of these fabrics with the consideration of their shrinkage and composition.

Two evenings per week.

In the *third year* instruction is given in multiple fabrics, chinchilla, Bedford cords, crepon, matelasse and imitations, double plains, meltons, kersey, plush and suitings. At this time also is taken up the construction of designers' blankets, suggestion cards, and the construction of samples.

The construction of new fabrics from theoretical viewpoint together with the construction from suggestion cards is taken up. In connection with this work instruction is given in making cost estimates for both woolen and worsted fabrics.

Two evenings per week.

314. **Cotton Weaving — 1 Year.**

The Course in Cotton Weaving covers instruction on plain looms, Draper Automatic and Stafford Automatic looms. It includes instruction on the construction of shedding and picking motions, take-up and let-off motions, together with the operation of the magazines and hoppers and methods of changing shuttle and bobbin. A study is also made of the preparation of warps, beaming, sizing and drawing-in. The Crompton and Knowles Automatic Towel Looms, and the various types of box looms, including chain building and work on multipliers, are also considered in this course.

One evening per week.

315. **Woolen and Worsted Weaving — 2 Years.**

This course includes instruction on the Crompton and Knowles loom and takes up general construction, head motions, take-up, let-off, filling stop

motion, etc. The preparation of warps, wet and dry dressing, is given in connection with this course.

One evening per week.

316. Dobby and Jacquard Weaving — 1 Year.

This course considers the various types of Jacquard heads and dobbies, which includes single cross border dobbies and leno attachments on double lift dobbies, handkerchief motions, leno weaving, center selvedge motions, filling changing looms, oscillating reeds, lappet motions, various shaker motions, towel and other pile cloth weaving. The course on Jacquard looms includes general construction, card cutting, lacing, repeating, and fixing.

One evening per week.

317. Freehand Drawing — 3 Years.

The *first year* work consists of charcoal drawing from casts, models, and group arrangements of still life.

Two evenings per week.

During the *second year* instruction is given in pencil sketching, colors, charts and color harmony, pen and ink drawing, and development of original motifs from various sources with color application.

Two evenings per week.

The *third year* work covers original designing for textile fabrics, wall paper and book cover work, pastel and water colors, and oil painting when the time will permit.

Two evenings per week.

CHEMISTRY AND DYEING DEPARTMENT

Hardly any branch of applied science plays so important a part in our industrial world as chemistry. Many large mills employ the chemists as well as the dyer, and with the great progress which is being made in the manufacture and application of dyestuffs, a basic knowledge of chemistry becomes an absolute necessity to the dyer. Within a comparatively short distance from Lowell are establishments employing men who require some knowledge of chemistry but who may not necessarily use dyes. Some find a knowledge of analytical chemistry helpful in their everyday work.

To meet these varying needs of our industrial community, the school offers a two-year course in general chemistry, organic and inorganic, which may be followed by any one of three courses, viz, textile chemistry and dyeing, analytical chemistry, and textile and analytical chemistry. In order to take Course 412, 413 or 414, candidates must have a certificate from Course 411, or show by examination or approved credentials that they have taken the equivalent of the work covered by this course.

411. Elementary Chemistry — 2 Years.

General Chemistry, including Inorganic and Organic.

Qualitative Analysis.

One lecture and one Laboratory Period per week in General Chemistry the first year, continued three nights a week during the second year, when the Elementary Organic Chemistry and Qualitative Analysis is completed.

Instruction in Elementary Chemistry extends through two years, and includes lectures, recitations and a large amount of individual laboratory work upon the following subjects:—

Theoretical Chemistry. — Chemical action, chemical combination, combining weights, atomic weights, chemical equations, acids, bases, salts, Avogadro's law, molecular weights, formulæ, valence, periodic law, etc.

Non-Metallic Elements. — Study of their occurrence, properties, preparation, chemical compounds, etc.

Metallic Elements. — Study of their occurrence, properties, metallurgy, chemical compounds, etc.

The students take up, as thoroughly as time will permit, the qualitative detection of the more common metals and non-metals, with practical work.

This work, although necessarily elementary, is intended to prepare the student to study more understandingly the manufacture of dyestuffs and coal tar colors in the more advanced courses which follow.

During the *first year* of the Elementary Chemistry course most of the time is devoted to the non-metals and theoretical chemistry, and the laboratory work covers briefly the non-metals.

Two evenings per week.

During the *second year* the classroom work is upon metals and the hydrocarbons and their derivatives, and the laboratory work consists entirely of Qualitative Analysis. While this course is necessarily taken up in an abbreviated and elementary manner, it is so arrranged that the students may become familiar with the separations and the detections of the common metals and acids. This course is also preliminary to the work given in Analytical Chemistry.

Three evenings per week.

412. Textile Chemistry and Dyeing — 3 Years.

Lectures in Textile Chemistry and Dyeing.

Laboratory Work in Dyeing.

Covered by 60 lectures and two nights of laboratory work per week.

The outline of the lecture course given in Textile Chemistry and Dyeing is as follows:—

Technology of Vegetable Fibers. — Cotton, linen, jute, hemp, china grass. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Animal Fibers. — Wool, mohair, silk. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Artificial Fibers. — Study of the various forms of artificial silk, the process of manufacture, their properties and action with chemicals, acids and heat.

Operations preliminary to Dyeing. — Bleaching of cotton and linen; wool-scouring; bleaching, fulling and felting of wool; carbonizing; silk-scouring and bleaching, action of soap.

The bleaching of cotton is studied with description of the various forms of kiers and machinery used; also the action of the chemicals used upon the material, and the various precautions that must be taken in order to insure successful work.

Under this heading is included a study of the reagents used in the emulsive wool-scouring process, and their action upon the fiber under various conditions; also the most successful of the solvent methods for degreasing wool.

Water and its Application in the Textile Industry. — Impurities present, methods for detection, their effect during the different operations of bleaching, scouring, dyeing and printing, and the methods used for their removal or correction.

The important subject of boiler waters is also studied under this heading, with a full discussion of the formation of boiler scale, its disastrous results, and the methods by which it may be prevented.

Mordants and Other Chemical Compounds used in Textile Coloring, and classified as Dyestuffs. — Theory of mordants, their chemical properties and application, aluminum mordants, iron mordants, tin mordants, chromium mordants, organic mordants, tannin materials, soluble oil, fixing agents, leveling agents, assistants, and numerous other compounds not dyestuffs that are extensively used in the textile industry.

Under this heading are included the definitions of various terms and classes of compounds used by textile colorists, such as color lakes, pig-

ments, fixing agents, developing agents, mordanting principles and leveling agents.

Natural Organic Coloring Matters. — Properties and application of indigo, logwood, catechu or cutch, Brazil wood, cochineal, fustic, turmeric, madder, quercitron bark, Persian berries, and other natural dyestuffs that have been used in recent years by textile colorists.

Mineral Coloring Matters. — Under this heading are discussed the properties of such inorganic coloring matters and pigments as chrome yellow, orange and green, Prussian blue, manganese brown, iron buff.

Artificial Coloring Matters. — General discussion of their history, nature, source, methods of manufacture, methods of classification and their application to all fibers.

Besides lectures and recitations upon the subject of Textile Chemistry and Dyeing, practical laboratory work is required. By the performance of careful and systematic experiments the student learns the nature of the various dyestuffs and mordants, their coloring properties, their action under various circumstances, and the conditions under which they give the best results. The more representative dyestuffs of each class are applied to cotton, wool and silk, and each student is obliged to enter, in an especially arranged sample book, a specimen of each of his dye trials with full particulars as to the conditions of experiment, percentage of compounds used, time, temperature of dye baths, etc.

For convenience and economy most of the dye trials are made upon small skeins or swatches of the required materials, but from time to time students are required to dye larger quantities in the full-sized dyeing machines.

413. Analytical Chemistry — 3 Years.

Laboratory Work and Lectures in Quantitative Analysis.

Three nights per week of class-room and laboratory work.

The object of this course is to give the student a general idea of the underlying principles of Analytical Chemistry, with a sufficient amount of laboratory work to enable him to become proficient in performing the ordinary routine analysis of the textile plant. Frequent recitations are held for the discussion of methods and the solution of stoichiometrical problems.

The work covered the first two years is based on Smith's "Quantitative Analysis," and for the advanced work, consists of the analysis of of soap, water, oils, cloth and other materials of particular interest to the textile chemist, special lecture notes and Griffin's "Technical Methods of Analysis" is used as a text.

414. Textile and Analytical Chemistry — 4 Years.

Lectures in Textile Chemistry and Dyeing.

Laboratory Work in Analytical Chemistry.

Combines all lectures in Textile Chemistry and Dyeing with work of Course 413, but does not include any Dyeing Laboratory.

Three nights per week.

TEXTILE ENGINEERING DEPARTMENT.

This department has arranged to offer those courses of study which lie at the foundation of all engineering. These are designed to give to those engaged in the mechanical, electrical, and manufacturing departments of mills, factories and other industrial establishments an opportunity to learn something concerning the theory underlying the many practical methods which they use in their daily work. Those subjects for which there is usually a regular demand are listed and described below, but similar and allied courses will also be arranged for provided there is a sufficient demand. In the case of all courses there must be an enrollment of at least ten properly qualified students to warrant giving the subject.

613. Mechanical Drawing — 3 Years.

For one having occasion to make a sketch or detail drawing for the purposes of illustration or instruction, or for one who is daily required to work from a drawing or blue print, the course in Mechanical Drawing is offered. It first lays a foundation of the principles of mechanical drawing, and follows this with two years' work in drawing directly from parts of machines, preparing both the detail and the assembly drawing.

This course is a complete course in drawing and requires *two evenings per week* for three years for its completion. The work is so planned that at its completion a man shall be thoroughtly familiar with the making of a working or shop drawing. After a study of the underlying principles of projections and instruction in penciling, inking, lettering and tracing, the subject of sketching and the making of detail drawings therefrom is especially stressed. The preparation of assembly drawings is finally considered.

614. Machine Shop Practice — 2 Years.

This course offers an opportunity to learn the art of metal working and is equally valuable to the man who already has some knowledge of the methods employed as to one who has no knowledge of the same. Thus it becomes possible for one who may be working at the bench during the day to learn how to operate a lathe or other machine tool, or for a lathe hand to acquire a knowledge of a planer, shaper, milling machine, or grinder. A series of lectures is given on the care and management of tools, tool grinding, and the mechanism of the machines. A man who only has a knowledge of the special machine he operates may by means of this course become a more intelligent machinist. He should supplement this study with the courses in Mechanical Drawing, and in Mechanics and Mechanism, in order that his training for an all-round machinist or mechanic may be more complete. The time required is *two evenings per week.*

619. Mechanics and Mechanism —2 Years.

This is one of the most important of engineering subjects dealing as is does with the principles which underlie the transmission of force and motion through machines and mechanical devices. Its principles are so fundamental and so widely used in more advanced subjects that the student should not consider himself qualified for further work until he has mastered the principles of this subject.

Beginning with a discussion of such important topics as work, power, horsepower, energy and the like, the student then studies the fundamental mechanical principles which are exemplified by the lever, jackscrew, pulley block, inclined plane, wedge, differential pulley and other similar devices. This is followed by consideration of the simpler relations pertaining to uniform and accelerated motion and the course concludes with a study of pulleys, belting, gears and gearing, as far as time permits. No student should undertake this course who is not thoroughly familiar with elementary mathematics. This subject requires attendance *two evenings per week* with home problem work and the study of a text book.

620. Mathematics — 2 Years.

This course is designed to permit the student to pursue further by evening study the mathematics of his grammar or junior high school course. It includes algebra, elementary trigonometry, logarithms and slide rule, and requires attendance for *two evenings per week.* It should be taken by all who intend to study further into engineering subjects. Instruction is largely through problem work in class and at home, and the use of a text book.

Some of the topics treated are—

Elementary algebraic operations of—
- Addition.
- Subtraction.
- Multiplication.
- Division.
- Factoring.
- Fractions.
- Graphical representation.
- Linear equations.
- Radicals.
- Quadratic equations.
- Logarithms.
- Slide rule.
- Trigonometry.

621. Strength of Materials — 1 Year.

This interesting subject deals with those important principles whereby the person engaged in machine, engine, mill or building design may ascertain whether the parts are strong enough to carry the forces and loads which the nature of the construction imposes upon them.

The fundamental stresses of tension, compression and shear are first considered, together with the ultimate strength of cast iron, wrought iron, steel, and timber. The practical use of this information is illustrated in the design of bolts, tie rods, columns, wall piers, boiler shells, riveted joints, etc. This is followed by a study of the stresses in and design of beams under various conditions of loading, and the course concludes with a discussion of the torsional stresses and twist in shafts. A knowledge of the principles of Mechanics and Mechanism is highly desirable to a satisfactory understanding of this subject. The time required is *one evening per week* and the method of instruction is through lectures, recitations, problems, and the use of a text book.

622. Steam — 1 Year.

It is the purpose of this course to study the various methods of heat generation, transmission, and utilization in use at the present day and to learn the theoretical relationship which underlie these processes and transformations.

The instruction covers, so far as time permits, the elements of steam engineering. The topics covered are heat and its measurement, use of steam tables, types of boilers, engines and turbines, boiler and engine room accessories, together with a study of the methods of testing the various types of apparatus. Actual tests on such equipment are made as the size of the class permits. Text book, laboratory and class work, and home problems are the methods of instruction used, requiring an attendance of *two evenings per week.*

623. Direct Current Electricity — 2 Years.

This popular course is planned to cover the fundamentals of direct current circuits and machinery. The lectures on electrical theory are supplemented by laboratory work and the use of a text book and problems. It requires for its completion attendance for *two evenings per week* and a considerable amount of home study and preparation. Students who wish to take this subject must have studied one year of algebra.

The fundamental properties of electrical and magnetic circuits are studied both in the classroom and laboratory. Other topics include the measurement of resistance, the calculation and measurement of power in direct-current circuits, and the relation between the electrical, heat and mechanical units of energy. A large amount of laboratory and class work is given to make the student familiar with methods of operation, testing and control of direct current machinery.

624. Alternating Current Electricity — 2 Years.

This course is similar to course 623 except that it deals with alternating current circuits and machinery. No student should plan to take this course unless he has previously taken at least one year of Course 623 or can show that he has had the equivalent.

The fundamental properties of alternating current circuits are first considered, and are followed by a study of the operation of alternating current machinery. The study of electrical measuring instruments is also included in this course. The instruction is given by means of lectures, recitations, and a large amount of laboratory work. An attendance of *two evenings per week* is required.

625. Power Plant Testing — 1 Year.

The purpose of this course is to teach the operating engineer how to test the various units usually found in a power plant. Numerical calculations are introduced and the interpretation of the results is of primary importance.

The following are some of the machines tested: engine, turbine, triplex pump, centrifugal pump, injector, etc. Various gages are also calibrated.

A test book is required and the class is held *two evenings per week.*

626. Mill Illumination — 1 Year.

Because of the demand by mill men, this course is offered for the first time to evening students. The class will be held *two evenings per week.*

Safety and production, factors entering into the design of lighting installations, industrial codes, costs and estimates are carefully considered. The laboratory exercises include the study of photometric curves of industrial units, study and use of the photometer, study of illumination by means of the Macbeth Illuminometer, and foot-candle meter.

The concluding work will be the complete design of a lighting installation, using the Institute laboratories or a local mill room.

Owing to limitations in apparatus, this course is open to a limited number of qualified men.

FINISHING DEPARTMENT.

In these courses machine work is supplemented by lectures and discussions pertaining to the many finishes given to fabrics. The action of soaps, water, steam, heat and cold upon cloth containing one fiber or combination of fibers as used in commercial fabrics is carefully studied. These courses also help the finisher to broaden his knowledge of textile fabrics. Attendance is required for *two evenings per week.*

710. Woolen and Worsted Finishing — 1 Year.

The outline of this course, which is given chiefly by means of lecture work, is as follows:

BURLING AND MENDING. — Under this head are taken up for consideration the examination of flannel as it comes from the loom; the construction, use and location of the perch; the methods used in marking defects, measuring, weighing and numbering of cloths; also the methods of inspection for fancies, single cloths and double cloths. The object of burling, mending and the types of tables employed, the method of removing knots, runners, etc., the object of back shearing and the use of burling irons, the replacing of missing threads and the importance of sewing as a part of the finishing process, are all considered in detail. The removal of oil and tar spots as well as stains of various kinds is studied.

FULLING. — This branch covers a study of the conditions of the flannel as it comes from the loom, and the influence of oil, etc., upon the procedure. Considerable time is devoted to the various methods of producing a felt, the various types of stocks and their modifications and development into the present type of rotary fulling mills of both single and double variety. The details of construction in all machines are carefully taken up and include the design and composition of the main rolls, methods of covering, regulation and means of adjusting the pressure of traps and rolls, and the use and regulation of the various types of stop motion, the different types of stretchers, guide rolls and throat plates.

The theory of felt is taken up and the influence of pressure, moisture,

heat, alkali and acid is considered, as well as the hydroscopic and felting properties of different wool fibers. The preparation of the flannel for the mill and the usual methods of determining shrinkages, as well as the various methods of soaping, are given careful attention. The preparation of various fulling soaps and the value of each for the production of various degrees of felt, as well as the determination of the proper amount of alkali for various goods, are carefully studied and demonstrated. The manipulation of the various kinds of goods in the mill, viz., all wool, reworked wools and mixed goods, is studied in classroom and by operation in the laboratory.

The change in weight and strength for each operation is carefully considered, as is also the value of the flocks made in each. A study of the various methods of flocking, such as dry and wet, is considered in both class and machine rooms. In each operation the defects likely to materialize are studied, as well as the cause thereof, and various methods of modifying or lessening them.

Washing and Speck Dyeing. — This branch considers the scouring, rinsing and washing of goods both before and after the fulling process; the various types of washers; and the details of construction, such as suds box, rolls, etc. The theory of scouring, uses of Fullers' earth, salt solutions and sours on the different kinds of goods are made clear by practical work in the machine room, where the effects due to improper scouring, such as stains, cloudy effects, wrinkles and unclean goods, are demonstrated. The discussion of the necessity of speck dyeing follows naturally from the study of these matters, and includes methods of preparation, meterials used, application and tests required.

Carbonizing. — This is an important branch of finishing, and includes a study of the various carbonizing agents, methods of application, strength of solutions and neutralizing, as well as the machines used. Stains and imperfections resulting from carbonizing are also considered. The drying and tentering machines and extractors employed are taken up at this point.

Gigging, Napping and Steaming. — The construction in detail of the various types of gigs, nappers, steamers, wet gigs, rolling, stretching, crabbing and singeing machines is discussed, and their actions upon the cloth and the results obtained are explained.

Various methods of obtaining luster and the production of permanent finish are considered in connection with steaming and sponging.

Brushing, Shearing and Pressing. — This includes, as do the other branches, a careful treatment of the machine employed, the preparation of the cloth for each process, the action of each machine in producing its part of the resultant effect. In manipulation of the shear consideration is given to its setting, grinding and adjustment. With the brushing machine the effect of steaming and moisture upon the luster and feel of the goods is shown. A study of the action of the presses, both plate and rotary, involves consideration of pressure, steaming, etc. Special processes to obtain particular effects are taken up, and the part played by each machine is explained. The details involved in handling cloth on a commercial scale, as, for example, measuring, weighing, ticketing, numbering and rolling, are also explained. The necessary calculation and the methods of finishing all grades of goods are considered from time to time during the year.

Two evenings per week.

711. Cotton Finishing — 1 Year.

The outline of the course in the finishing of cotton fabrics is as follows:—

Cloth Room. — Instruction of the various goods and the objects thereof; construction of the various types of inspecting and trimming machines.

Shearing. — The object. A consideration of the various types of shears for treating one or both sides at the same time; also the use of the usual

cleaning devices, such as emery, sand and card rolls, beaters and brushes; grinding and the adjustment of the various parts.

The use of brushing and cleaning machines, rolling devices and calender attachments for gray goods.

Singeing. — Developing and object of singeing; the construction of singers of all types, and for various purposes; the use of cooling tanks, steaming devices, rolling and brushing attachments.

Regulation of the flame for various goods, and adjustment of the parts; gas and air pressure, water-cooled rolls; the effect of moisture on the cost of singeing; the use of dry cans in connection with singeing; electric singeing.

Washing. — Open width and string washers, their construction and operation; soaps, temperature, squeeze rolls; washing of various goods and the object thereof; stains.

Napping. — The object of napping and the usual method of treating goods; various types of nappers, single and double acting; felting nappers; construction, grinding and adjustment of various types.

Water Mangles. — Their object and construction of various types; various rolls,—iron, husk, etc.; scutchers, their object and construction.

Starch Mangles. — The object and construction of all types of starch mangles for pure starch and filled goods; various types of rolls, — brass, rubber, wood; action of doctor blades, etc.; regulation and object of pressure.

Methods of starching and finishing all standard goods, also a consideration of the various substances used, such as starch, softener and fillers; the preparation of starch and various methods of application.

Dryers and Stretchers. — Both horizontal and vertical, tenter frames, clips; the swing motion and the finishes thus produced; construction; spraying machines, belt stretchers, button breakers; their object and construction.

Calenders. — The object and construction of all types, including the regulation of pressure and nips for the production of various finishes; various types of rolls and their uses, — steel, husk and paper; the use of hot and cold rolls; chasing, friction, embossing and Shriner calenders and the various finishes produced by each; production of watered effects; beetling machines.

Making up room, — yarding, inspecting; different types of folds; pressing, papering, marking.

Two evenings per week.

EVENING GRADUATES OF 1930.

Certificates awarded as follows, April 8, 1930:

Cotton Manufacturing — 4 Years.

Minton Albro Winslow . . . . . Nashua, N. H.

Worsted Manufacturing (Bradford System) — 4 Years.

Maurice Jones . . . . . . Methuen, Mass.

Woolen Yarns — 2 Years.

George Edward Hertrich . . . . Lawrence, Mass.

Worsted Yarns — 2 Years.

David Eaton Arthur . . . . . Methuen, Mass.
Henry Adolf Fink . . . . . Roslindale, Mass.

Cotton Design — 3 Years.

Andrew Clark Jenkins, Jr. . . . . Lowell, Mass.
Roy Percival Rutter . . . . . Lawrence, Mass.

Woolen and Worsted Design — 3 Years.

John Andrew Calnin	Lowell, Mass.
Frederick William Gatenby	No. Chelmsford, Mass.
James Harrington Kennedy, Jr.	Lowell, Mass.
George Richard Welch	No. Chelmsford, Mass.
Walter Joseph Wilson	Methuen, Mass.

Freehand Drawing — 3 Years.

Anamay Smith Brady	Lowell, Mass.
Albini Alfred Dufresne	Lowell, Mass.
Helen Mary Weilbrenner	Lowell, Mass.

Cotton Weaving — 1 Year.

Gordon Calkins	Dracut, Mass.
Thomas Michael Collins	Lowell, Mass.
Charles Hartwell Hale	Lowell, Mass.

Dobby and Jacquard Weaving — 1 Year.

Parker Sprague Goss	Concord, Mass.

Woolen and Worsted Weaving — 2 Years.

Antonio Octave Bedard	Lowell, Mass.
George Coates	Methuen, Mass.
John Alfred Ebhardt	Lawrence, Mass.
Robert Frederick Hickey	Methuen, Mass.
George Sumner Orr	Lawrence, Mass.
Benjamin Harrington Shaw, Jr.	Waltham, Mass.

Cotton Finishing — 1 Year.

Peter Henry Malay	Nashua, N. H.
John Russell Nash	Nashua, N. H.

Woolen and Worsted Finishing — 1 Year.

Joseph Allen, Jr.	Lawrence, Mass.
Henson Haverstock Brown	Andover, Mass.
Lewis Medley Daniels	No. Billerica, Mass.
John Frank	Lawrence, Mass.
Chester Matthews	No. Billerica, Mass.
Wilfred David Rochon	Andover, Mass.

Textile and Analytical Chemistry — 4 Years.

Theodore Kapala	Lowell, Mass.

Textile Chemistry and Dyeing — 3 Years.

John Rostron Berwick	Lawrence, Mass.
Lawrence Manuell Ralph Davidson	Nashua, N. H.
Hubert Arthur Fletcher	Methuen, Mass.
William Edward Schmottlach	Lawrence, Mass.

Elementary Chemistry — 2 Years.

Walter Samuel Bean, Jr.	Lowell, Mass.
Howard Bingham	Methuen, Mass.
Richard Warwick Bower	Methuen, Mass.
Russell Coleman	Lowell, Mass.
William Edward Coulton	Lawrence, Mass.
Edward Lawrence Dinneen	Lowell, Mass.
Francis Charles Dinneen	Lowell, Mass.
Howard Clinton Hatch	Lawrence, Mass.
Helen McMahon	Lowell, Mass.
Mary Ruth Maguire	Lowell, Mass.
John James Murphy	Medford, Mass.

Harris Verrill Petelle	Methuen, Mass.
Raymond James Schuster	Lawrence, Mass.
Ernest Walter Turcotte	Lowell, Mass.
Dumont Rudolphe Vigneault	Lowell, Mass.
Wilbur Lane Williams	Lowell, Mass.

Mechanical Engineering — 3 Years.

Reginald Joshua Lherault	No. Chelmsford, Mass.

Mechanical Drawing — 3 Years.

Alexandre Arthur Nault	Lowell, Mass.

Direct Current Electricity — 2 Years.

Wilfred Bottomley	No. Andover, Mass.
John Milton Cole	Methuen, Mass.
Richard Wallace Hall	Graniteville, Mass.
Wilfrid Hardman	Lowell, Mass.
Clarence Wadsworth Hope	Lowell, Mass.

Alternating Current Electricity — 2 Years.

Roy Edward Blanchard	Graniteville, Mass.
Edgar Roland Born	Methuen, Mass.
Harry Francis Christie	Lawrence, Mass.
Harry Sidney Forty	Graniteville, Mass.
Edward George Haines	Lowell, Mass.
Thomas William Johnson	Methuen, Mass.
James Alexander Kelly	Lowell, Mass.
Arthur Long	Methuen, Mass.

Machine Shop Practice — 2 Years.

William Joseph Ahearn	Lowell, Mass.
Wilfred Eugene Beaudoin	Lawrence, Mass.
George Henry Dumais	Lowell, Mass.
William Joseph Dumais	Lowell, Mass.
Harold Trueworthy Nickles	Lowell, Mass.
James John Troup	Lowell, Mass.

Power Plant Machinery — 1 Year.

Alfred Samuel Cady	Lowell, Mass.
Origene Joseph Coté	Lowell, Mass.
Charles Sumner Lewis	Lowell, Mass.
Paul Louis Mertrud	Lowell, Mass.

Mathematics — 2 Years.

William Joseph Ahearn	Lowell, Mass.
John Aponovitch	Nashua, N. H.
Leo Romuald Bisson	Lowell, Mass.
Raymond Arthur Brodeur	Lowell, Mass.
George Francis Carroll	Lowell, Mass.
Agnes Constance Crete	Lowell, Mass.
Paul Howard Evans	Lowell, Mass.
Frank Vincent Flanagan	No. Andover, Mass.
Doris Louise Gifford	Lowell, Mass.
Edna Virginia Gifford	Lowell, Mass.
John Joseph Grigas	Nashua, N. H.
Everett Alvah Hilliard	Lowell, Mass.
Edward Joseph Jennings	Lowell, Mass.
Enar Emanuel Johnson	Lowell, Mass.
Howard Simpson Jones	Billerica, Mass.
Desmond Alexander McElholm	Lowell, Mass.
Timothy Francis O'Sullivan	Lowell, Mass.

Stuart Luke Potter	No. Billerica, Mass.
Joseph John Richards	Lowell, Mass.
Paul Richards	Lowell, Mass.
George William Riley	Lowell, Mass.
John Denis Rogers	Lowell, Mass.
Cedric Walter Stanley	Lowell, Mass.
Henry Andrew Strok	Lowell, Mass.
Joseph Augustus Sullivan	Lowell, Mass.
Fred Taylor	No. Billerica, Mass.

SERIES 34, No. 2

November, 1930

BULLETIN

OF THE

Lowell Textile Institute

LOWELL, MASS.

Issued Quarterly

1930-1931

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1917, authorized October 21, 1918

Moody Street and Colonial Avenue

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2500. 12-'30. Order 649.

Single Process Picking vs. Two Process Picking

By GILBERT R. MERRILL, B. T. E., *Professor of Textiles*

In Charge of

DEPARTMENT OF COTTON YARNS AND KNITTING

Lowell Textile Institute

(The data, on which this bulletin is based, were taken from a study carried on in the Department of Cotton Yarns by Mr. Harmon Howorth, a senior student.)

The purpose of this study was to compare the yarns spun from cottons passed through a single process picker with those spun from the same cotton passed through two processes of picking.

With the exception of picking, the cotton was processed on the same machines, with the same settings and wherever possible, at the same time. All of the processing was carried on in the Cotton Yarns Laboratory, where the atmosphere is automatically controlled at 53 per cent relative humidity.

In order that the laps should be produced under commercial conditions, it was arranged to have one of the large cotton mills, having both single process and two process pickers, prepare the laps. It was necessary to use a cotton available in this mill, which in this case was 1⅛ inch Peeler of Low Middling grade. The laps were both 12 oz. laps.

All the cotton was opened through a hopper bale breaker and one vertical opener.

The two process breaker laps were made on a two beater picker having one three blade beater and one two blade beater. The finisher picker used a Kirschner beater.

The single process lap was made on a machine with two Buckley beaters followed by one Kirschner beater.

The plan called for a 30s carded yarn from single roving and a 20s carded yarn from double roving, made under the following organization.

Picker Lap		12 oz.
Card Sliver		55 grains
First Drawing Sliver		55 grains
Second Drawing Sliver		55 grains
Slubber Roving		.50 hank
Intermediate Roving		1.30 hank
Fine Roving		3.75 hank
Yarn	Single Roving	30's
	Double Roving	20's

A study of the laps received from the mill, showed that the two process lap was slightly cleaner than the single process lap. However, the waste tests at the card showed 6.5% waste collected from the single process lap, as compared with 5.9% waste collected from the two process lap. (This would lead to the question of whether the excess dirt in the lap is removed in carding.)

During the preparatory processing, attention was given to any possible difference in the way the stock ran. As far as could be seen, there was no difference in the processing qualities of the stock.

The yarns spun were marked carefully to keep them separate, and were tested after five hours exposure at standard conditions in the automatically controlled Testing Laboratory.

One skein break was made from each of twenty bobbins for each count and each set. These tests were made on a Scott Vertical Tester of 150—300 lbs. capacity, at a speed of 12 inches per minute, for the moving spool.

The actual counts were determined from the weights of the broken skeins.

Ten single strand strength tests were made from each of the 20 bobbins using a Schopper water pressure tester, using a 250 millimeter length and a lower jaw speed of 12 inches per minute.

As the single strand tests were made, the elongation at the breaking point was recorded.

The twists per inch were counted at 10 places on each of 10 bobbins to check the twist in the four sets of yarns.

Another series of tests was made by use of the special equipment developed at the Cotton Research Laboratory to measure the variations in the single strands of yarn.

The yarns were also wound on examination boards to get a visual comparison of the four lots.

The detailed data of this test is collected in thirty-five pages of typewritten figures, from which much of the following summary is obtained. The remaining figures are obtained from the others, and are used to make comparisons more accurate.

For example, the twist multipliers have been found for counts 20 and 30 by using the actual twists per inch.

The strength constants have been found by multiplying the actual counts by the strength of the skeins. This was done also for the single strand break. Within small limits, it is generally agreed that the counts times the strength of a yarn gives a constant which makes direct comparison possible.

The variation in counts is taken from the figure obtained from the 120 yard weighings.

The variation in skein strength is similarly obtained and is introduced to go with the count variation and the variation from the mirror testing apparatus for single strand variation.

SUMMARY OF DATA

Yarns	30		20	
Processes	2	1	2	1
Counts, Actual	29.46	31.62	20. 41	20.74
Twists, Actual	23.80	23.10	17.90	16.80
Twist Multiplier	4.34	4.21	4.00	3.76
Strength, Skein	54.38	49.60	88.10	86.90
Constant	1602	1568	1798	1802
Strength, Single Strand	256	237	387	380
Constant	7541	7494	7899	7881
Variation, Counts	2.99%	4.45%	4.03%	2.13%
Skein Strength	32.20%	22.20%	26.10%	20.70%
Mirror Strand	17.10%	13.90%	14.30%	13.50%

The author of the study sets up five points to consider.

1. How do the amounts of waste in carding compare?
2. Relatively, how does the stock process?
3. Which yarn is stronger?
4. Does one yarn have a greater elongation than the other?
5. What is the relative degree of uniformity?

In connection with the data already tabulated, he concludes as follows:

"1. The waste in carding was .6% greater on the One Process lap than on the Two Process lap.
2. Comparatively, the stock runs equally well throughout manufacture using either the One Process or the Two Process laps.
3. The Two Process and One Process yarns showed equal strengths."

(In this connection note that for the 30s, while the one process yarn strength constants were slightly less, the yarn had slightly less twist. For the 20s, the one process yarn had a higher strength constant for the skein break and a slightly lower constant for the single strand break, but the twist multiplier was considerably lower.)

"4. By comparing relative elongations, no definite decision can be made, since the amounts were not consistent, but seemed to average about the same.
5. The One Process lap gives a little more uniform yarn."

(From the skein weights the relative uniformity of the lots of both counts is contradictory but based on the skein strength and the single strand variation measurements, the single process yarn is more uniform. Notice that these seem to be rather consistent. A study of the yarns wound on examination boards showed no particular difference. As far as this method was concerned there was no choice.)

Southwick Hall

SERIES 34, NO. 3

February, 1931

Bulletin

of the

Lowell Textile Institute

LOWELL, MASS.

Issued Quarterly

1931

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under Act of Congress of July 16, 1894
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Moody Street and Colonial Avenue

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6,600 2-31 Order 1385.

CALENDAR

1930–1931

September 11–12, Thursday–Friday	Entrance Examinations
September 15–19, Monday–Saturday	Re-examinations
September 18, Thursday, 9.00 A.M.	Registration for Freshmen
September 22, Monday	Registration for upper-class students Classes begin for Freshmen
September 23, Tuesday	Classes begin for upper-class students
October 13, Monday	Holiday — Observance of Columbus Day
November 25, Tuesday, 4.45 P.M.	Thanksgiving recess begins
December 1, Monday, 9.00 A.M.	Thanksgiving recess ends
December 19, Friday, 4.45 P.M.	Christmas recess begins
January 5, Monday, 9.00 A.M.	Christmas recess ends
January 19, Monday	First term examinations begin
January 30, Friday	End of first term
February 2, Monday	Second term begins
February 23, Monday	Holiday — Observance of Washington's Birthday
March 27, Friday, 4.45 P.M.	Spring recess begins
April 6, Monday, 9.00 A.M.	Spring recess ends
April 20, Monday	Holiday — Observance of Patriots' Day
May 25, Monday	Second term examinations begin
May 30, Saturday	Memorial Day — Holiday
June 9, Tuesday	Commencement
June 11–12, Thursday–Friday	Entrance Examinations

1931–1932

September 10–11, Thursday–Friday	Entrance Examinations
September 14–19, Monday–Saturday	Re-examinations
September 17, Thursday, 9.00 A.M.	Registration for Freshmen
September 21, Monday	Registration for upper-class students Classes begin for Freshmen
September 22, Tuesday	Classes begin for upper-class students
October 12, Monday	Columbus Day — Holiday
November 11, Wednesday	Armistice Day — Holiday
November 24, Tuesday, 4.45 P.M.	Thanksgiving recess begins
November 30, Monday, 9.00 A.M.	Thanksgiving recess ends
December 18, Friday, 4.45 P.M.	Christmas recess begins
January 4, Monday, 9.00 A.M.	Christmas recess ends
January 18, Monday	First term examinations begin
January 29, Friday	End of first term
February 1, Monday	Second term begins
February 22, Monday	Washington's Birthday — Holiday
March 25, Friday, 4.45 P.M.	Spring recess begins
April 4, Monday, 9.00 A.M.	Spring recess ends
April 19, Tuesday	Patriots' Day — Holiday
May 23, Monday	Second term examinations begin
May 30, Monday	Memorial Day — Holiday
June 7, Tuesday	Commencement
June 9–10, Thursday–Friday	Entrance Examinations

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Instructor in Machine Shop Practice

Albert Greaves Sugden . . . . 673 School Street
Instructor in Weaving

Arthur Joseph Woodbury . . . . 41 Morey Street
Instructor in Cotton Yarns

Russell Metcalf Fox . . . . 359 Beacon Street
Instructor in Textile Design

Charles Arthur Everett, B.T.C. . . . . 38 Riverside Street
Instructor in Dyeing

James Harrington Kennedy, Jr. . . . . 177 A Street
Instructor in Wool Yarns and Sorting

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Richard Omer Pero Assistant Instructor in Woolen Yarns	298 Pawtucket Street
Harold William Russell Assistant Instructor in Cotton Yarns	78 Gates Street
John Joseph McDonald Assistant Instructor in Chemistry	208 Mount Hope Street
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HISTORICAL SKETCH
of the
LOWELL TEXTILE INSTITUTE

By virtue of legislative acts of 1928, the Lowell Textile School became known as the Lowell Textile Institute in order to more clearly define the standing of the institution. This was the natural result of the development of the original ideas and policies of the trustees who founded the Lowell Textile School. The articles of incorporation were authorized by Chapter 475, Acts of 1895, and provided for a corporation to be known as the Trustees of the Lowell Textile School of Lowell, Massachusetts. The movement for the establishment of the school dates from June 1, 1891, but it was not opened for instruction until February 1, 1897.

In accordance with the acts of incorporation the Board of Trustees consisted of twenty permanent and self-perpetuating members, three-fourths of whom must be "actively engaged in, or connected with, textile or kindred manufactures." In addition, his Honor the Lieutenant-Governor, the Commissioner of Education of the State, the mayor, the president of the municipal council, the superintendent of schools of Lowell, and a representative of the textile council were members *ex-officio*. Legislative acts of 1905 and 1906 authorized the graduates of the school to elect four trustees serving for periods of four years each.

By virtue of the anti-aid amendment to the State Constitution, and by Chapter 274, General Acts of 1918, the property of the school was transferred on July 1, 1918, to the Commonwealth of Massachusetts, and the control and management of the school was vested in a Board of Trustees appointed by the Governor, "with all the powers, rights and privileges and subject to all the duties" of the original Board.

In locating the Institute at Lowell, which has been called the "Mother Textile City of America," considerable advantage is secured by close association with every branch of the industry, which utilizes almost every commercial fiber in the products of the great Merrimack Valley textile district.

Although the school was formally opened by Governor Roger Wolcott on January 30, 1897, in rented quarters in the heart of the city, it was not until January, 1903, that the first buildings of the present plant were ready for occupancy. On February 12, 1903, Governor John L. Bates dedicated the present buildings.

PURPOSE AND SCOPE OF THE INSTITUTE

The object of the establishment of the Institute as set forth in the original act was "for the purpose of instruction in the theory and practical art of textile and kindred branches of industry."

The plan was occasioned by the apparent crisis in the leading industry of New England, due to the rapid development of the manufacture of the coarser cotton fabrics in the southern States. It was believed that this crisis could be met only by a wider and more thorough application of the sciences and arts in the production of finer and more varied fabrics.

Following the general methods and systems found successful at the higher polytechnic institutes, it offers thorough instruction in the principles of the sciences and arts applicable to textile and kindred branches of industry. The courses treat not only of the theory but also the application of these principles in the processes, on the machines and throughout all departments of industry involved in the successful manufacture, application and distribution of textile material in any form.

Though from the first the management has kept in view the clearly defined objective which called for the establishment of the Institute, it has developed its curriculum, its methods of instruction, and equipment as the needs of the industry arose. This objective will be kept constantly in view, and as new demands are presented an effort will be made to extend courses, equipment and floor space. The mechanical equipment of the Institute includes the best makes of textile machinery, and these machines, while built as they would be for regular work, are, as far as possible, adapted to the experimental work which is of particular value in such an institution as this.

Because of the breadth, grade and character of instruction given, and because of the standing and personnel of the instructing staff, the Institute has been placed by both Federal and State educational boards in the class of the higher technological schools of this country.

The United States Civil Service Commission recognizes graduates from the degree courses of this school as proper applicants for the examination to the various positions requiring a knowledge of applied science and engineering, as well as a knowledge of textile manufacturing, in the different departments of the government.

The day classes have been organized for those who can devote their entire time for three or more years to the instruction requisite in preparing to enter the textile industries. It has been found necessary to require of all such students educational qualifications equivalent to those given by a regular four-year course of a high school or academy of good standing.

The evening classes are held for about twenty weeks of the year, and are for those who are unable to attend the day courses. These are similar to the day courses, but are aimed especially to meet the needs of students working during the day in the mills and shops. For entrance to these classes an applicant should have the equivalent of a grammar school education. A detailed description of these courses and requirements is given in another Bulletin, which will be sent upon request.

BUILDINGS AND GROUNDS

The site is a commanding one, consisting of about 15 acres at a high elevation on the west bank of the Merrimack River. It extends to and overlooks the rapids of Pawtucket Falls, which was the first water power in America to be used on an extensive scale to operate power looms. It was contributed by Frederick Fanning Ayer, Esq., of New York City, and the Proprietors of the Locks and Canals on the Merrimack River.

Southwick Hall, the main building, fronting on Moody Street, was contributed by the Commonwealth of Massachusetts and Frederick Fanning Ayer, Esq., and is a memorial to Royal Southwick, a leading textile manufacturer, a public man of earlier days, and a maternal ancestor of Mr. Ayer. It includes a central mass 90 by 90 feet, having three stories and two wings 80 by 85 feet each with two stories and well-lighted basements. The building is pierced in the center by an arched way from which access is had to the wings and to the central courtyard. The northern wing is occupied by the General Offices, Engineering and Finishing Departments, and Library, while the southern wing is entirely occupied by the Chemistry and Dyeing Departments.

Kitson Hall, dedicated to the memory of Richard Kitson, was contributed by Charlotte P. Kitson and Emma K. Stott, his daughters; the Kitson Machine Company of Lowell, founded by Mr. Kitson, was also a generous contributor. This hall makes a right angle with Southwick Hall, is 70 by 183 feet, and has two stories and a basement. The first floor is occupied by the Cotton Yarn and Knitting Departments, while the basement contains the Mechanical and Electrical Engineering laboratories and the Machine Shop.

The Falmouth Street Building forms the third side of the quadrangle, and consists of three portions, one 60 by 75 feet, three stories, one 75 by 130 feet, three stories, and the head house 70 by 80 feet, three stories and basement. The building is occupied by the picker section of the Cotton Yarn Department, the Design and Power Weaving Department and by the Woolen and Worsted Yarn Department, and contains on the lower floors an equipment for the manufacture of wool yarn from the fleece to the finished yarn. The upper floors are occupied by a great variety of plain, dobby and Jacquard looms, and in a section of the building are the students' lockers and recreation rooms.

Colonial Avenue Building was erected in the summer of 1910 from plans prepared by the Engineering Department, which also had in charge the work of construction. The building completes the fourth side of the quadrangle, and in outward appearance corresponds to the architectural features of the other school buildings. It is a single-story building, and has the dimensions of 195 by 60 feet. Its interior is faced with cement brick made at the school during the progress of the

work. These serve to give light-reflecting walls which are advantageous for the work of the Wool Manufacturing, Cotton Finishing and Chemistry and Dyeing Departments that occupy this building. The funds for this building were provided by the State of Massachusetts.

The buildings are of modern mill construction adapted to educational uses and contain approximately 180,563 square feet.

CAMPUS

Through the generosity of Mr. Frederick Fanning Ayer the Institute has been provided with a campus and athletic field of about 3 acres. This has beeen carefully graded and laid out for baseball, football and track athletics.

To enclose this field the Alumni Class Fence has been partly built. It is made of forged iron sections supported between brick columns. Each section is contributed by a class, so that in the course of a few years this fence will entirely enclose the field.

On the upper floor of the Falmouth Street Building there has been provided a recreation room for the use of the students at such times as their attendance is not required in classes.

In the basement of this building there are rooms for the use of the athletic teams. Connected to these are showers and dressing rooms.

The upper hall of Southwick Hall has been equipped with gymnastic apparatus. Chest weights, wooden dumb-bells, Indian clubs, a set of traveling rings, a vaulting horse, parallel bars, a punching bag and several sets of foils and single sticks have been provided.

In order to be sure that no student having any dangerous physical weakness takes part in any athletic contest, all candidates for the various athletic teams are obliged to pass a satisfactory physical examination.

ENTRANCE REQUIREMENTS

Particular stress should be laid upon a thorough grounding in mathematics, including algebra, arithmetic and plane geometry, as these form the basis upon which the work of this school rests. While solid geometry is not required at the present time, the student will find a knowledge of this subject very valuable in his subsequent work, and is strongly recommended to include this subject as one of his electives. A preliminary course in science, including physics and chemistry, serves to prepare the student's mind for the higher branches of these subjects and their application, but neither will be considered as the equivalent of the courses in these branches given in the Institute.

Degree Courses

Candidates for admission to either of the degree courses must be graduates of a school approved by the New England College Entrance Certificate Board or by the board of Regents of New York, and must present a certificate from the principal of the school last attended, reporting upon the subjects pursued and the points obtained according to the schedule of studies given hereafter. A total of fourteen points is required.

A point represents satisfactory work in a year's study in a specified subject in an approved secondary school.

Required Subjects

Algebra A1	1
Algebra A2	1
English	4
Elementary French A (two years) or Elementary German A (two years)	2
Plane Geometry	1
History (American, Medieval and Modern, or English)	1
Physics	1
	11

Elective Subjects

	Points
Chemistry	1
Elementary French (two years) or Elementary German (two years)	2
Advanced French or German (one year in addition to requirements of Elementary French A or Elementary German A)	1
History:	
American	1
Medieval and Modern	1
English	1
Latin	1
Mechanical Drawing	1
Mechanic Arts	1
Solid Geometry	1
Spanish	1
Trigonometry	1

An applicant may also be admitted on the basis of entrance examinations, in which case he must pass a sufficient number of the required subjects to make ten points and present certificates showing satisfactory courses in such of the elective subjects to make three additional points.

The objective of the elective requirements is to encourage greater breadth of preparation than that covered by the required branches. Certificates covering other subjects than those listed as elective will be entertained.

Diploma Courses

Candidates for admission to the diploma courses are accepted upon presentation of properly vouched certificates showing the completion of a regular four-year course in a high school or academy of reputable standing. The certificate must specify that the applicant has satisfactorily passed the required subjects.

A total of twelve points is required.

Required Subjects	Points
Algebra A1	1
Algebra A2	1
English	4
Plane Geometry	1
History (American, Medieval and Modern, or English)	1
Physics	1
	9

Elective Subjects

Three may be selected from the list under Degree Courses.

ENTRANCE EXAMINATIONS

All students who are unable to present a certificate for either the degree or the diploma courses must pass entrance examinations. Notification of intention to take these examinations must be made in writing at least a week before the date of the examinations. These will be held as follows:—

Thursday, June 11, 1931; Thursday, September 10, 1931; Thursday, June 9, 1932:—

Algebra, 9 A.M. to 11 A.M.
History, 11 A.M. to 1 P.M.
English, 2 P.M. to 4 P.M.

Friday, June 12, 1931; Friday, September 11, 1931; Friday, June 10, 1932:—

Plane Geometry, 9 A.M. to 11 A.M.
German or French, 11 A.M. to 1 P.M.
Physics, 2 P.M. to 4 P.M.

Candidates failing to pass the June examinations are allowed to try again in September; those who cannot attend the June examinations may present themselves in September.

REQUIRED SUBJECTS FOR ENTRANCE

Algebra A1.—Derivation and use of simple formulas, graphical representation, the meaning and use of negative numbers, linear equations, with one or two unknown quantities, ratio and proportion, the essentials of algebraic technique, simple cases of exponents and radicals.

Algebra A2.—Numerical and literal quadratic equations in one unknown quantity, the binomial theorem for positive integral exponents, arithmetic and geometric series, simultaneous linear equations in three unknown quantities, simultaneous equations consisting of one quadratic and including graphical solutions, exponents and radicals.

Plane Geometry.—The usual theorems and constructions of good textbooks, including the general properties of plane rectilinear figures, the circle and the measurement of angles, similar polygons, areas, regular polygons, and the measurement of the circle. The solution of original problems and problems in mensuration of lines and plane surfaces.

English.—As secondary schools are following to a greater extent than heretofore the requirements of the College Entrance Examination Board, it is recommended that the applicant to this school conform to the suggestions of this Board relative to English composition and literature.

The examination consists of two parts, both of which are given at the same time.

(*a*) With the object of testing the student's ability to express his thoughts in writing clearly and correctly he will be required to write upon subjects familiar to him. Emphasis will be laid upon the composition, punctuation, grammar, idiom and formation of paragraphs. He will be judged by how well he writes rather than by how much he writes.

(*b*) The second part of the examination is prepared with the view of ascertaining the extent of the student's knowledge of good literature, and to test this examination questions will be based on the books adopted by the National Conference on Uniform Entrance Requirements. Any course of equivalent amount if made up of standard works will be accepted.

History.—Applicants may offer a preparation of American history, English history, or medieval and modern history.

In American history applicants should be familiar with the early settlements in America, the colonies, their government, the customs of the people, and events which led to the establishment of the United States. They should be informed concerning the causes and effects of the principal wars in which the country has been involved. They should be prepared to consider also questions requiring an elementary knowledge of civil government, as well as historical facts connected with the growth of this country up to the present time.

For the subject of English history or medieval and modern history the course given in any reputable secondary school should give proper preparation. A course extending over a full year with not less than three periods a week will be accepted.

Physics.—The applicant should be familiar with the fundamental principles of physics, particularly those considered under the headings of mechanics, heat, light, electricity and magnetism. Textbook instruction should be supplemented by lecture table experiments. Wherever possible, the student should pursue a laboratory course, but for the present no applicant will be conditioned in this subject if he has not been able to carry on a laboratory course. Where a laboratory course is offered by a secondary school, it should cover at least twenty-five of those experiments listed in the syllabus of the College Entrance Examination Board.

Modern Languages.—Required for degree courses only. It is expected that the work in these subjects has covered a period of at least two years of preparatory school training or the equivalent. Importance should be given to the ability to translate into good idiomatic English, but attention should also be paid to grammar and construction, that greater care may be used in translation.

Elementary German A.—The entrance examination is composed of two parts, both taken, however, at the same time.

(*a*) Translation of simple German prose into good idiomatic English.

(*b*) Questions to test proficiency in grammar, and simple English sentences to be rendered into German.

The requirements include the declension of articles, adjectives, pronouns and nouns; the conjugation and inflection of weak and strong verbs; the simpler uses of the subjunctive; the use of the modal auxiliaries; the prepositions and their uses; the principal parts of important verbs; and the elementary rules of syntax and word order.

Texts used in the language courses of any reputable high or preparatory school will furnish reading for translation. A list of texts is offered by the College Entrance Examination Board.

Elementary French A.—The entrance examination is composed of two parts, both taken, however, at the same time.

(*a*) Translation of simple French prose into good idiomatic English.

(*b*) Questions to test proficiency in grammar, and simple English sentences to be rendered into French.

The requirements include the principal parts, conjugation and inflection of the regular and the more common irregular verbs; the singular and plural forms of nouns and adjectives; the uses of articles and partitive construction; the forms and positions of personal pronouns; and the simpler uses of the conditional and subjunctive.

Suitable texts are suggested by the language courses of any reputable high or preparatory school and by the requirements of the College Entrance Examination Board.

Students who have pursued two years of elementary French as well as two years of elementary German may present one subject to cover two points in the required subjects, and the other to cover two points in the elective subjects.

ELECTIVE SUBJECTS

History.—If the applicant can present all three or any two branches of history specified he may include one as a required subject and the others in the list of elective subjects.

Chemistry.—Applicants must show evidence of their familiarity with the rudiments of chemistry. Any course given in a secondary school organized to present instruction by means of textbook or lecture, together with correlated laboratory work, will be considered as covering the requirements. The applicant's notebook with his original notes, including description of experiment, apparatus used, reactions, observations and deductions, must be accompanied by his instructor's certificate.

Importance will be placed upon manipulation and deductions as well as the general appearance and neatness of the notebook.

Solid Geometry.—The usual theorems and constructions of good textbooks, including the relations of planes and lines in space, the properties and measurement of prisms, pyramids, cylinders and cones; the sphere and spherical triangles. The solution of original problems and the applications of the mensuration of surfaces and solids.

Trigonometry.—The usual courses of instruction covered by the standard textbooks on plane and spherical trigonometry will prepare an applicant sufficiently to meet this requirement.

Mechanical Drawing.—The applicant must have pursued such a course in mechanical drawing that he will be familiar with the usual geometrical construction problems, projection of points, lines, planes and simple solids.

Importance is laid not only upon the accuracy with which the work is performed, but upon the general arrangement, appearance and care with which the plates are executed.

It should not be understood that work in this subject may be offered as the equivalent of the first term's work at the Institute.

Mechanics Arts.—The usual courses offered by properly equipped preparatory schools will be accepted as suitable fulfilment of this requirement. Work should include instruction in the handling of both wood and metal working tools in the more simple practices of these arts.

Elementary French B.—Applicants who enter for one of the three-year courses may present one year's work in French in a secondary school. Those who present themselves for examination in this subject should be familiar with the rudiments of grammar, and be able to translate simple French prose into good idiomatic English, also to translate into French English sentences, based on the French given for translation.

Elementary German B.—Applicants who enter for one of the three-year courses may present one year's work in German in a secondary school. What is stated in regard to French applies to those who may present German instead of French.

Advanced French or German.—In cases where applicants have pursued courses in French or German for more than two years, and have completed work which is more advanced than is included under elementary French or German, they may offer the additional year as an elective.

Spanish.—Students offering Spanish should be familiar with elementary grammar, the common irregular verbs, and be able to translate simple Spanish to English or English to Spanish. A preparation equivalent to three periods per week for two years will be acceptable.

Latin.—Students who have pursued one or more years of Latin may present this subject as an elective. Each year's work satisfactorily completed will be considered equal to one point.

ADVANCED STANDING

Candidates who may have received previous training in any of the subjects scheduled in the regular course will, upon presentation of acceptable certificates, be given credit for such work.

GRADUATE COURSES

Graduates of technical courses of other schools are invited to communicate with the president with reference to special courses in the textile studies. Previous training in the sciences and the engineering branches will usually reduce materially the time necessary to complete any of the courses at the Institute. The advantages

offered to such persons for special research work are unexcelled, and a most profitable course may be arranged.

COURSES OF INSTRUCTION

Degree Courses.—The four-year degree courses are as follows:

Textile Engineering.

Chemistry and Textile Coloring.

At the completion of these courses the degrees of Bachelor of Textile Engineering (B.T.E.) and Bachelor of Textile Chemistry (B.T.C.) are conferred.

Five options are offered in the Engineering Course, viz., general textile, cotton manufacturing, wool manufacturing, design, or sales option. Each of these courses is planned to train one in the fundamental principles of science found to be applicable in the particular fields of textile chemistry and textile engineering. It is maintained that for one to be successful in either of these important branches of industry a training is required as thorough and broad as that of any of the recognized branches of engineering or of applied science.

With this in mind these courses have been built of a secure framework of science and mathematics, and to it has been added the useful application of these branches in the broad textile field. With the direct purpose of laying a secure foundation in the training, a more extended preparatory course is first demanded, and subsequently in the school work more subjects of a general character are included, that narrowness of judgment and observation may not result by overstimulation of the technical development.

Diploma Courses.—The following courses extend over a period of three years and upon the completion of any one of these the diploma of the Institute is awarded:

Cotton Manufacture.

Wool Manufacture.

Textile Design.

These are the original courses offered at the Institute, arranged to require three years' study and to give the student as thorough a training as possible for his chosen field, stressing particularly the study of textiles.

COURSES FOR WOMEN

Although all classes are open to women, the courses which have appealed especially to their tastes have been textile designing and decorative art. Some have pursued courses in chemistry, and have added to their work in design some instruction in power weaving and finishing. These special courses have in general been followed for three years, and in some cases have led the students to positions either in the mill office or in some commercial lines that have been desirable and have offered congenial work.

Within the last few years the possibilities for women in certain branches of textile chemistry have become recognized, and it is believed that in the future the positions open to them will become more and more numerous.

GENERAL INFORMATION

Application for Admission.—A blank form of application for admission may be found at the end of this bulletin. This should be properly filled out by all applicants, whether entering upon certificate from a secondary school or presenting themselves for examination.

Freshman Registration.—Each freshman is expected to be in daily attendance beginning Thursday, September 17, at 9.00 A.M., and to follow the prepared program which will be placed in his hands. A program which is planned to acquaint the new student with the institution, its location and surroundings, its courses of instruction, its recreational activities and other phases of its life is arranged for the opening week. Unless arrangements for room and board are made previously, the first two days of the week may be used for this purpose. Physical examinations as well as certain other tests are given during this orientation period. Freshman week enables the student to secure the advantages which come from acquaintance with his surroundings, his instructors, the members of his class, student organiza-

tions, activities and customs. The overcrowding of the first week of classes with distractions is thus avoided.

Registration.—All upper classmen are required to register on or before the Monday of the week beginning the school year, and all students during the midyear examination period. For unexcused delay in registration a fee of $5 will be imposed.

Sessions.—The regular school sessions are in general from 9.00 A.M., to 12.50 P.M., and from 1.55 to 4.45 P.M., except Saturdays, when no classes are held. On Saturday afternoons the buildings are closed.

An hour plan designates the hours at which the various classes meet. This is rigidly adhered to, and the student is marked for his attendance and work as therein scheduled.

Attendance.—Attendance is required of all students on fourteen-fifteenths of all scheduled class exercises, provided they meet the requirements of their instructors for the omitted exercises. For every unexcused absence from any class exercise in excess of those allowed, a deduction from the mark obtained in the course in which the absences occurred will be made.

Advisers.—Advisers are appointed for all students, to be of such aid and assistance as they can both inside and outside of school hours. The head of the department in which a student is registered is adviser to upper-classmen, and instructors in charge of freshmen classes act as advisers to freshmen.

Conduct.—Students are required to return to the proper place all instruments or apparatus used in experimental work, and to leave clean and in working order all machinery and apparatus with which they may experiment. All breakages, accidents or irregularities of any kind must be reported immediately to the head of the department or instructor in charge.

Irregular attendance, lack of punctuality, neglect of either school or home work, disorderly or ungentlemanly conduct or general insubordination are considered good and sufficient reasons for the immediate suspension of a student, and a report to the trustees for such action as they deem necessary to take.

It is the aim of the trustees so to administer the discipline of the Institute as to maintain a high standard of integrity and a scrupulous regard for trust. The attempt of any student to present, as his own, work which he has not performed, or to pass an examination by improper means, is regarded by the trustees as a most serious offense, and renders the offender liable to immediate suspension or expulsion. The aiding or abetting of a student in any dishonesty is also held to be a grave breach of discipline.

Any student who violates these provisions will be immediately suspended by the president, and the case reported at the following meeting of the trustees for action.

Examinations.—For first-year students examinations are held every five weeks, and these serve to inform the student concerning his standing and the progress made.

For students in upper classes examinations will be held during the eighth week of each term.

Final examinations are held at the end of each term.

In general, the examinations cover the work of the preceding term, but at the discretion of the instructor may include work of earlier terms.

Examinations for students conditioned in first-term subjects are held during the second term, and examinations for students conditioned in the second-term subjects are held in September following. Students requesting condition examinations at other than scheduled dates will be required to pay $5 for each examination so taken.

Any student who fails to complete a subject satisfactorily or to clear a condition at the time appointed, will be required to repeat the subject, and he cannot be admitted to subjects dependent thereon.

A student whose term's standing is as a whole so low that he cannot continue with profit the work of the next term will be required to leave, but he may return the following year to repeat such subjects as are required.

Daily work and regularity of attendance are considered in making up the reports of standing.

Records and Reports of Standing.—During each term informal reports are sent to parents or guardians of all students under age, and to all students; and at the end of each term formal reports are made.

The daily work of the student forms an important part of his record, and no pupil will be awarded the diploma or degree unless this portion of his record is clear.

Books are prescribed for study, for entry of lecture notes and other exercises, and are periodically examined by the lecturers. The care and accuracy with which these books are kept are considered in determining standing.

Thesis.—Each candidate for the degree of the Institute must file with the head of the department in which the thesis is taken, and not later than May 15, a report of original investigation or research, written on a good quality of paper, 8½ by 11 inches, with one-inch margin at left, and one-half inch at right, of each page; such thesis to have been previously approved by the head of the department in which it is made.

For all candidates for the diploma this requirement will be optional on the part of the Institute.

Library and Reading Room.—That the students may have surroundings conducive to reading and study a moderate-sized reading room with library tables and chairs has been provided. The library shelves contain textile, art, engineering and scientific publications. These are increased from time to time as new technical books of value to textile students are issued from the press. The leading textile papers are kept on file for ready reference.

FEES, DEPOSITS, ETC.

Tuition Fee.—The fee for the day course is $150 per year for residents of Massachusetts. For non-residents the fee for all courses is $200 per year. The fee for students from foreign countries is $300 per year.

Three-fifths of the fee is charged for a single term. Each term's tuition is payable during the first week of that term. Students failing to make this payment at the specified time will be excused from classes until satisfactory explanation and arrangements for payment can be made. *No bills will be sent.* After payment is made no fee or part thereof can be returned, except by special action of the trustees.

Special students pay, in general, the full fee, but if a course be taken involving attendance at the school during a limited time, application may be made to the president for a reduction.

Students entering from Massachusetts are required to file with the Bursar a statement signed by either town or city clerk, stating that the applicant's father is a legal resident of Massachusetts.

Athletic Fee.—An athletic fee of $15 is due and payable at the time of the first payment of tuition.

Deposits.—For all first-year students a minimum deposit of $25 is required to cover the cost of breakage, supplies, apparatus and chemicals used in the Chemical Laboratory, the unexpended balance to be returned to the student at the end of the year. For all students in second, third, and fourth years taking work in Chemistry and Dyeing Laboratories a deposit of $25 for the first term and $25 for the second term is required.

Students taking Machine Shop will be required to make deposit of $15 to cover cost of materials, supplies and breakage. Included in this charge is a kit of tools which is essential to the work and which becomes the personal property of the student. The unexpended balance will be returned at the end of the year.

Students not taking Chemistry Laboratory or Machine Shop will be required to make a deposit of $10 each year to cover general breakage. The unexpended balance will be returned at the end of the year.

All deposits must be made before students can be admitted for laboratory work.

Rooms and Board.—Students from a distance, requiring rooms and board in the city, may, if they desire, select same from a list which is kept at the Institute. The cost of rooms and board in a good district is $12 per week and upwards.

Books and Materials.—Students must provide their own books, stationery, tools, etc., and pay for any breakage or damage that they cause. The above fee includes free admission for any day students desiring to attend any of the evening classes in which there is accommodation.

All raw stock and yarn furnished to the students, and all the productions of the Institute, remain or become its property, except by special arrangement; but each student is allowed to retain specimens of yarn or fabrics that he has produced, if mounted and tabulated in accordance with the requirements of the department. It is understood that the department may retain such specimens of students' work as they may determine.

Lockers are provided for the use of the students, sufficiently capacious to contain clothing, books and tools.

No books, instruments or other property of the Institute are loaned to the students to be removed from the premises except by special permission.

Summary of Expenses per Year

Tuition (residents of Massachusetts)	$150
Tuition (residents of other States)	200
Tuition (foreigners)	300
Chemistry laboratory deposit (1st year)	25
Chemistry laboratory deposit (2d, 3d and 4th years)	50
Athletic fee	15
Machine shop deposit	15
General breakage fee	10
(This applies to students who do not take chemistry or machine shop.)	
Books and supplies	50
(Books and supplies for the first year cost about $80, second and third year $35, and fourth year $50, thus averaging about $50 per year for the four years.)	

SCHOLARSHIPS AND PRIZES

The Massachusetts Charitable Mechanic Association Scholarship.—The Massachusetts Charitable Mechanic Association has offered six scholarships of $250 each which are for the purpose of defraying school expenses of such students as may be selected by a committee composed of a representative from the association, one from the Board of Trustees and the President of the Institute.

Herbert A. Currier Scholarship.—Herbert A. Currier, of the class of 1906, has offered a prize of $100 to a student who may be selected by the faculty of the Institute, and in making the selection the following conditions will be considered: scholastic standing, financial need, and ability in promoting student activities in school life. The scholarship will be awarded to a member of the sophomore, junior or senior class.

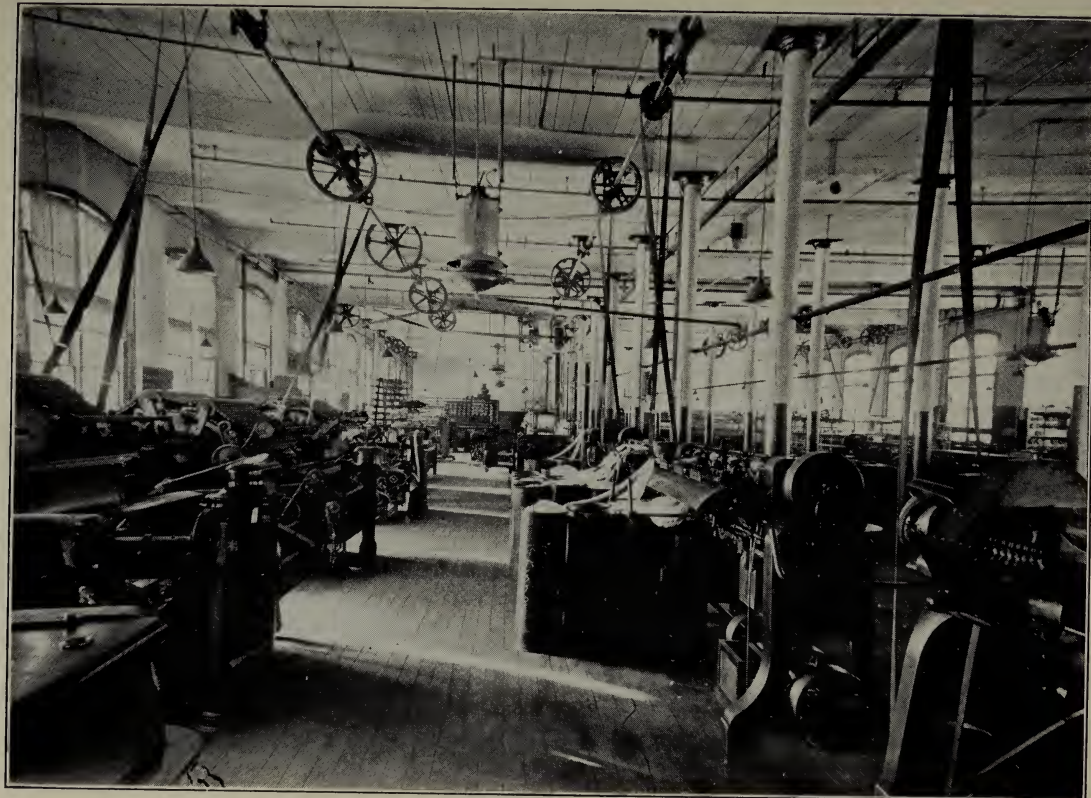
Textile Colorist Award.—The Textile Colorist, Inc., has offered a prize of $100 to be awarded to a member of the graduating class whose thesis, based upon his personal researches and experiences, is of the greatest practical value to the dyeing, bleaching or textile finishing industries.

Louis A. Olney Book Prize.—Prizes in the form of books are awarded each year to the successful candidate on graduation day. The conditions in detail are as follows:—

First.—Ten dollars to the student taking the regular Chemistry and Textile Coloring Course who shall be considered as having attained the highest scholarship in first-year chemistry.

Second.—Five dollars to the student taking the regular Chemistry and Textile Coloring Course who shall be considered as having attained the second highest scholarship in first-year chemistry.

Third.—Ten dollars to the regular student of the Chemistry and Textile Coloring Course who shall be considered as having obtained the highest scholarship during his second year.



Cotton Yarn Department

Fourth.—Five dollars to the regular student of the Chemistry and Textile Coloring Course who shall be considered as having attained the second highest scholarship during his second year.

Fifth.—Twenty dollars to the regular student in the Chemistry and Textile Coloring Course who shall present the best thesis preparatory to graduation.

The above-mentioned sums are to be invested in books which may be selected after graduation. In case no one is considered worthy of any particular scholarship prize, or if there is no competition, the same may be withheld. The decision in such case shall rest with the judges.

The National Association of Cotton Manufacturers Medal.—The National Association of Cotton Manufacturers offers a medal to that member of the graduating class who, during his course, shall have attained the highest standing in special subjects required by the vote of the association.

STUDENT ACTIVITIES AND ORGANIZATIONS

School Publications.—The Text is issued bi-weekly and it contains news pertaining to activities in the Institute as well as information concerning alumni. The Pickout is an annual publication in charge of a manager and editor selected from the senior class. The board is composed of representatives from the various classes.

Fraternities.—There are four fraternities, three of which are national and one is local. They afford opportunity for social life desired in a college career.

Dramatic Club.—The Dramatic Club gives annually a theatrical program at the Lowell Auditorium. Appropriation is made from the profits to the treasury of the Athletic Association.

Professional Clubs.—A Student Section of the American Society of Mechanical Engineers holds meetings regularly in accordance with requirements of the national organization. The Student Section of the American Society of Dyers and Colorists hold meetings at which papers are delivered or speakers come from outside the school organization.

Honor Society.—To degree candidates who have maintained a high scholarship for three years' work, or who have met with certain similar requirements, is accorded the honor of membership in the society Tau Epsilon Sigma. Relatively a membership in this society corresponds to that in some of the well-known honor societies of the liberal arts and scientific colleges. It requires constant attendance and application to the work of the course for any student to reach the scholarship level entitling him to this membership.

Honor Roll.—The President's List includes upper classmen taking a regular course who have a general average of eighty percent and no deficiencies.

Co-operative Society.—This society is maintained for the benefit of students who desire to purchase supplies and materials for use in connection with their work. It is operated under the direction of a manager and assistant manager and one or more clerks. The general business policy is under the supervision of a member of the faculty. Students who join the society are entitled to discount privileges when purchasing from the society and from certain firms in the city of Lowell.

Alumni Association.—The Alumni Association of the Institute holds its annual meeting and banquet in May of each year.

The membership of the association is composed of graduates of the day courses and is open to any non-graduate who has attended the Institute for at least one year.

Officers for the Year 1930–31

Frank L. McCool, '10, *President*
Charles H. Forsaith, '20, *Vice-President*
Arthur A. Stewart, '00, *Secretary-Treasurer*

Communications should be addressed to Arthur A. Stewart, Lowell Textile Institute.

Ex-Officio Members of Executive Committee

Edward M. Abbot, '04
Henry A. Bodwell, '00
Thomas T. Clark, '10
Ralph K. Hubbard, '11
Frank L. McCool, '10
T. Ellis Ramsdell, '02
Royal P. White, '04

Executive Committee

15 *Members*

Philip H. Warren, '05
Alexander Campbell, '23
James F. Dewey, '04
Leonard S. Farr, '08
Russell T. Fisher, '14
Charles H. Forsaith, '20
Olin D. Gay, '08
Brackett Parsons, '20
Everett B. Rich, '11
Richard M. Sawyer, '27
Dean W. Symmes, '22
Ernest D. Walen, '14
J. Milton Washburn, '21
A. Edwin Wells, '20
Stanley H. Wheelock, '05

SUBJECTS OF INSTRUCTION

In the column headed "Hours of Exercise" the numbers represent for each particular subject the total hours required in school for a period of fifteen weeks.

The letter and number which follow the subjects indicate the department in which the subject is given and the number of the subject in that department. For detailed description of the same, see page 34.

The departments are indicated as follows:—

Textile Engineering	B	Cotton Yarns	F
Chemistry and Textile Coloring	C	Woolen and Worsted Yarns	G
Textile Design and Power Weaving	D	Finishing	H
Languages and History	E		

By referring to the letter and number indicated under "Preparation" the student can ascertain what subjects are necessary in order that he may have a clear understanding of the subject which he is scheduled to take.

First Year

First Term

(Common to all Courses)

	Hours of Exercise
Elementary Chemistry C–10	105
English E–10	45
Mathematics B–10	45
Mechanical Drawing B–13	135
Physics B–11	75
Physical Education	30
Textile Design and Cloth Analysis D–10	90

Second Term

	Course IV	Course VI
Elementary Chemistry C–10	90	45
Elementary German E–11	30	–
English E–10	45	45
Machine Drawing B–14	–	120
Mathematics B–10 or B–10a	45	75
Mechanism B–12 or B–12a	45	75
Physical Education	30	30
Qualitative Analysis C–13	150	–
Stoichiometry C–14	30	–
Technology of Fibres C–11, F–10 and G–10	45	45
Textile Chemistry C–12	15	15
Textile Design and Cloth Analysis D–10	–	75

For second-term subjects in Courses I, II, and III, see pages 21, 23, 25.

Course I.—Cotton Manufacture

The Cotton Manufacturing Course is designed for students contemplating a career in the manufacturing of cotton yarns, cloth or allied industries, and wishing to devote but three years to instruction at the Institute.

During the first term the studies are common to all courses, and include instruction in mathematics, mechanical drawing, physics, textile design and elementary chemistry.

During the second term, lectures in organic chemistry are given followed by lectures in textile chemistry and dyeing the second year. The work in mechanism serves as a basis for all future machine and mechanical work, and is followed by steam engineering, electricity and mill engineering. The course in textile designing, cloth analysis and cloth construction includes lectures on plain and fancy weaves and Jacquard, the analysis of all commercial fabrics, and designs for the same.

Power weaving is taken up during the second and third years. Commencing with lectures and practice upon plain looms, the instruction continues with dobby, box-loom, and Jacquard weaving.

A course in knitting taken during the third year includes the manufacture of flat goods, hosiery and underwear. Considerable laboratory practice accompanies the lecture work, giving the students actual working knowledge of a wide range of knitting machines. Instruction in the finishing of cotton fabrics is given by lectures and laboratory work, and requires considerable work on standard machines in the laboratory. Textile testing, also given in the third year, instructs the student in standard methods for physical testing of textile material.

In the second term of the first year, instruction in the technology of fibers is given. The student is instructed regarding cotton growing areas and cotton cultivation. The commercial cottons and their peculiarities, cotton classing and the involved system by means of which cottons are marketed, are also considered.

The work of the second year in the Cotton Yarn Department continues the study started in the first year, stressing particularly cotton carding, that is, the operations of opening, picking, carding, combing, drawing and roving. The instruction consists of lectures supplementing available textbooks. A considerable time is spent in the laboratory studying cotton fibres and classing, followed by operating and adjusting the various machines studied during the year.

The third year's work continues that of the second year, with detailed study of spinning, spooling, twisting and winding. Another course gives instruction in mill organization, balancing and arranging machinery in the mill. Finally, a brief course is given in the use of the microscope and camera in studying various problems in cotton manufacture. Laboratory practice supplements the lecture course, giving practical operation, adjustment and observation of the machines studied. Advanced laboratory work illustrates the methods of study and analysis of the more general and complex problems such as are usually handled in the laboratory of a textile plant.

During both the second and third years, particular attention is given to the preparation of the various reports in order that the student may learn proper methods for presenting data and conclusions resulting from mill studies and tests.

During the third year, each student makes some original study, usually of a technical nature. He must make a formal report of this study satisfactory to the faculty before receiving his diploma.

For detailed description of the subjects see page 34.

Course I.—Cotton Manufacture

[For first term see page 19]

First Year. Second Term. (Hours of Exercise)

Elementary Chemistry C–10	45	Technology of Fibers C–11, F–10, G–10	45
English E–10	45	Textile Design and Cloth Analysis D–10	135
Machine Drawing B–14a	90	Textile Chemistry C–12	15
Mathematics B–10b	45		
Mechanism B–12	75		
Physical Education	30		

Second Year. First Term

Cotton Yarn Manufacture F–20	225	Textile Chemistry and Dyeing Lect. C–21	30
Physics B–22a	45	Textile Design and Cloth Analysis D–20	75
Power Weaving D–22	120		
Steam Engineering B–24	30		

Second Year. Second Term

Cotton Yarn Manufacture F–20	255	Textile Design and Cloth Analysis D–20	60
Physics B–22a	45		
Power Weaving D–22	165		

Third Year. First Term

Cotton Finishing H–31	75	Mill Engineering B–34a	30
Cotton Organization F–32	60	Power Weaving D–31	135
Cotton Yarn Manufacture F–30	165	Textile Testing G–31	30
Economics E–30	45	Thesis F–34.	
Electricity B–31a	30		

Third Year. Second Term

Cotton Finishing H–31	75	Knitting F–31	120
Cotton Research Laboratory F–33	15	Power Weaving D–31	135
Cotton Yarn Manufacture F–30	180	Thesis F–34.	

Course II.—Wool Manufacture

The course on wool manufacturing is arranged for those who contemplate a career in the manufacture of woolen or worsted fabrics, and can devote but three years to the school work. It includes instruction on all of the varied processes employed in manipulating the wool fiber to produce yarn and cloth, namely, sorting, scouring, carding, combing, spinning, designing, weaving, dyeing and finishing. The work is carried on by lectures, recitations and practical work in the laboratories.

Following the first term of the first year, which is common to all courses, the student taking technology of fibers becomes acquainted not only with the various kinds of wool and trade terms applied to them, but also with other commercial fibers, viz., cotton, silk, jute, hemp, flax, etc., used in the textile industry. He is at the same time taught the application of these fibers and the general processes of manufacturing each into a yarn.

Beginning with the second year the details of manipulating wool from the grease to the finished yarn is taken up for close study. This includes the spinning of woolen yarn, also worsted yarn, by both the English and the French systems. The intermediate processes of sorting, scouring, carding, combing and top-manufacturing are taken in detail and in proper sequence.

The general chemistry of the first year is followed by a lecture course in the second year on textile chemistry and dyeing.

Textile design, cloth analysis and construction are continued from the first year throughout the course, the work being applied especially to woolen and worsted goods. Weaving on power looms commences in the second year and continues through the third.

Lectures on finishing commence with the third year and are augmented by extensive practice with the machines in the Finishing Department.

Work in the Engineering Department extends throughout all three years, and includes mechanical drawing, steam engineering and electricity. The practical application of the principles studied in these subjects is brought out forcibly in the work on mill engineering, where mill design and construction are considered. A short course covering methods employed in the testing of fibers, yarns, and cloths, together with laboratory work in the manipulation of certain physical apparatus, is given in the third year.

For detailed description of the subjects see page 34.

Course II.—Wool Manufacture

[For first term see page 19]

First Year. Second Term. (Hours of Exercise)

Elementary Chemistry C–10	45	Technology of Fibers C–11, G–10, F–10	45
English E–10	45	Textile Chemistry C–12	15
Machine Drawing B–14a	90	Textile Design and Cloth Analysis D–10	135
Mathematics B–10b	45		
Mechanism B–12	75		
Physical Education	30		

Second Year. First Term

Physics B–22a	45	Textile Chemistry and Dyeing Lect. C–21	30
Power Weaving D–22	90	Top Manufacture G–20	240
Steam Engineering B–24	30		
Textile Design and Cloth Analysis D–21	90		

Second Year. Second Term

Physics B–22a	45	Top Manufacture G–20	285
Power Weaving D–22	135		
Textile Design and Cloth Analysis D–21	60		

Third Year. First Term

Electricity B–31a	30	Power Weaving D–31	135
Finishing H–30	75	Textile Testing G–31	30
Mill Engineering B–34a	30	Yarn Manufacture G–30	225

Third Year. Second Term

Finishing H–30	75	Yarn Manufacture G–30	240
Knitting F–31	120	Thesis.	
Power Weaving D–31	90		

Course III.—Textile Design

The general course in textile design is planned to meet the demand of young men for a technical training in the general processes of textile manufacturing, but with particular reference to the design and construction of fabrics. To this end a foundation is laid in the first year by instruction in the elementary principles of designing, decorative art and weaving. That he may later in the course pursue to advantage instruction in yarn manufacturing, weaving, dyeing, finishing and some engineering problems, a foundation course in mechanics, mathematics and chemistry is laid. As the student is required to pursue courses in the yarn departments, both cotton and wool, he acquires a knowledge of the manufacture of cotton yarns from the bale to the yarn, and of woolen and worsted yarns from the fleece through the varied processes of manufacturing woolen yarn or worsted yarn by both the French and Bradford systems.

Throughout his entire course he receives instruction in design, cloth analysis and construction of all the standard cloths, viz., trouserings, coatings, suitings, blankets, velvets, corduroys, plushes, etc. This is followed by advanced work in Jacquard designing and weaving, which serves not only to acquaint the student with the many kinds of cotton, woolen, worsted and silk fabrics of figured design, but stimulates and develops any artistic talent he may possess. Decorative art becomes an important part of the work of the second and third years.

The course in general inorganic and organic chemistry of the first year leads to the subject of textile chemistry and dyeing in the second year.

Power weaving commences with the second year and continues throughout the course, and work on all types of looms is required.

During the third year the student receives instruction in the finishing of cotton goods and woolen and worsted cloths. This instruction is given by means of lecture and laboratory work.

The engineering subjects given in the second and third years are intended to acquaint the student with such general knowledge as will be of assistance should he be called upon in later life to be a mill manager, or should his subsequent progress lead to some executive position in the operation of a textile plant.

For detailed description of the subjects see page 34.

Course III.—Textile Design

[For first term see page 19]

FIRST YEAR. SECOND TERM. (HOURS OF EXERCISE)

Elementary Chemistry C–10	45	Technology of Fibers C–11, F–10, G–10	45
English E–10	45	Textile Chemistry C–12	15
Machine Drawing B–14a	90	Textile Design and Cloth Analysis D–10	135
Mathematics B–10b	45		
Mechanism B–12	75		
Physical Education	30		

SECOND YEAR. FIRST TERM

Cotton Yarn Manufacture F–20a	120	Textile Chemistry and Dyeing Lect. C–21	30
Cotton Yarn Manufacture F–30a	30	Textile Design and Cloth Analysis D–20, 21	195
Physics B–22a	45		
Power Weaving D–22	75		
Steam Engineering B–24	30		

SECOND YEAR. SECOND TERM

Cotton Yarn Manufacture F–20a	45	Textile Design and Cloth Analysis D–20, 21	195
Cotton Yarn Manufacture F–30a	30	Top Manufacture G–20	90
Physics B–22a	45		
Power Weaving D–22	120		

THIRD YEAR. FIRST TERM

Cotton Finishing H–31	75	Textile Testing G–31	30
Electricity B–31a	30	Woolen and Worsted Finishing H–30	75
Mill Engineering B–34a	30	Worsted Yarn Manufacture G–30	90
Power Weaving D–31	60		
Textile Design and Cloth Construction D–30	135		

THIRD YEAR. SECOND TERM

Cotton Finishing H–31	75	Woolen and Worsted Finishing H–30	75
Power Weaving D–31	135	Worsted Yarn Manufacture G–30	60
Textile Design and Cloth Construction D–30	180	Thesis.	

Course IV.—Chemistry and Textile Coloring

The four-year course in Chemistry and Textile Coloring, leading to the degree of B.T.C., is especially intended for those who wish to engage in any branch of textile chemistry, textile coloring, bleaching, finishing or the manufacture and sale of the dyestuffs or chemicals used in the textile industry. The theory and practice of all branches of dyeing, printing, bleaching, scouring and finishing are taught by lecture work supplemented by a large amount of experimental laboratory work and actual practice in the dyehouse and finishing room.

The underlying theories and principles of chemistry are the same, no matter to what industry the application is eventually made. Furthermore, no industry involves more advanced and varied applications of the science of chemistry than those of the manufacture and application of the coal-tar coloring matters. In addition, the textile colorist must consider the complex composition of the textile fibers, and the obscure reactions which take place between them and the other materials of the textile industry.

During the first year general chemistry, including both inorganic and organic, is taught by lectures and laboratory work, and this is supplemented during the second term by qualitative analysis and stoichiometry.

Advanced inorganic chemistry, as well as advanced organic chemistry, is studied during the second and third year as a continuation of the elementary chemistry of the first year, and much time is spent upon quantitative analysis, industrial chemistry, and textile chemistry and dyeing.

The foundation work in general chemistry is continued during the third year with courses in physical chemistry, organic laboratory work and analytical work. The subject of industrial chemistry is introduced, and much time is devoted to advanced textile chemistry, dye testing, color matching, calico printing, and woolen, worsted and cotton finishing.

The fourth year is characterized by an endeavor to present certain subjects of a more applied nature in such a manner that the student's reasoning power and ability to apply the knowledge gained during the first three years may be developed to the fullest extent. The subject of engineering chemistry is introduced, and the work in the Dyeing and Analytical Laboratories is applied as far as possible to the actual requirements of the factory chemist and colorist. The student is given a thorough course in microscopy, photomicrography and the use of the various instruments, such as the spectroscope, ultra-microscope, polariscope, tintometer, etc., which often prove of vital importance in the advanced study of textile chemistry. During this fourth year the student devotes much time in the Organic Laboratory in the manufacture of dyestuffs. This is followed by such research work or original investigation as time will permit. Upon this he must present a satisfactory thesis, or report, before receiving his degree.

For detailed description of the subjects see page 34.

Course IV.—Chemistry and Textile Coloring

[For first year see page 19]

SECOND YEAR. FIRST TERM. (HOURS OF EXERCISE)

Advanced German E–21	30	Stoichiometry C–20	15
Adv. Inorganic Chemistry C–23	30	Textile Chemistry and Dyeing Lab. C–22	105
Mathematics B–20a	45	Textile Chemistry and Dyeing Lect. C–21	30
Physics B–22a	45		
Quantitative Analysis C–25	195		
Steam Engineering B–24	30		

SECOND YEAR. SECOND TERM

Advanced German E–21	30	Stoichiometry C–20	15
Adv. Inorganic Chemistry C–23	30	Textile Chemistry and Dyeing Lab. C–22	150
Adv. Organic Chemistry C–24	30	Textile Chemistry and Dyeing Lect. C–21	30
Mathematics B–20a	45		
Physics B–22a	45		
Quantitative Analysis C–25	150		

THIRD YEAR. FIRST TERM

Adv. Organic Chemistry Lect. C–34	30	Economics E–30	45
Adv. Textile Chemistry and Dyeing Lab. C–32	120	Industrial Chemistry C–31	30
Adv. Textile Chemistry and Dyeing Lect. C–32	30	Quantitative Analysis C–30	165
		Technical German C–35	30
		Woolen and Worsted Finishing H–30	75

THIRD YEAR. SECOND TERM

Adv. Textile Chemistry and Dyeing Lab. C–32	75	Organic Laboratory C–36	105
Adv. Textile Chemistry and Dyeing Lect. C–32	15	Physical Chemistry C–33	30
Economics E–30	45	Quantitative Analysis C–30	120
Industrial Chemistry C–31	30	Technical German C–35	30
		Woolen and Worsted Finishing H–30	75

FOURTH YEAR. FIRST TERM

Adv. Textile Chemistry and Dyeing Lab. C–45	90	Photography C–46	15
Adv. Textile Chemistry and Dyeing Lect. C–45	30	Physical Chemistry C–44	45
Engineering Chemistry C–42	30	Quantitative Analysis C–48	15
Engineering Chemistry Laboratory C–43	30	Report Writing C–49	15
Organic Laboratory C–41	90	Technical German C–40	30
		Textile Marketing B–44	30
		Textile Testing G–31	30
		Thesis C–50	75

FOURTH YEAR. SECOND TERM

Adv. Textile Chemistry and Dyeing Lab. C–45	90	Organic Laboratory C–41	105
Adv. Textile Chemistry and Dyeing Lect. C–45	15	Physical Chemistry C–44	60
Engineering Chemistry C–42	15	Report Writing C–49	15
Microscopy and Photomicroscopy C–47	45	Technical German C–40	30
		Thesis C–50	150

Course VI.—Textile Engineering

This course is the four-year general textile course leading to the degree of Bachelor of Textile Engineering (B.T.E.), and aims especially to fit men, in the broadest possible manner, to meet the increasing demands of every branch of the textile industry for men with combined textile and technical preparation. The magnitude and scope of the textile and allied industries fully justify the most thorough technical training possible for all who aspire to leadership in this field.

The student is first thoroughly grounded in those fundamental principles of science upon which all industrial and engineering work rests. The foundation of his textile and technical training is in the subjects of mathematics, physics, chemistry, drawing, mechanics, mechanism, and technology of fibres, and their practical application.

Instruction is given in all the various branches of textile manufacturing through lectures, recitations and laboratory work. A large proportion of his time is spent in well-equipped textile departments where he studies and operates all of the machinery required in the conversion of cotton and wool fiber into yarns and fabrics. This includes cotton, wool and worsted yarn manufacturing, designing, weaving, knitting, dyeing and finishing. In his last year the course in textile testing acquaints the student with the methods for determining the physical properties of textile fibers, yarns and fabrics.

To properly equip the student to meet the varied engineering problems which confront the mill manager or executive, or to so train him that he may enter those industries closely allied to the textile, instruction is given by lecture and laboratory practice in the several branches of engineering.

Steam engineering considers the problems involved in steam generation and distribution for power, heating and manufacturing purposes, includes the testing of laboratory and power plant equipment, and leads to the design of power plants. The course in electrical engineering includes a study of the generation and transmission of electrical power, the testing of direct and alternating current machinery, and is intended to acquaint the student with modern practice.

Mill engineering familiarizes the student with mill design, construction, heating, lighting, humidification and fire protection. The arrangement of machinery and buildings for most efficient production and economical power distribution is also studied in detail.

The broadening effect of such subjects as English, language, industrial history and economics is carried still further in this course by carefully planned courses in business administration, accounting, cost accounting, business and patent law.

During the fourth year the student is required to conduct an original investigation of some textile or allied problem, and to submit the results in the form of a satisfactory thesis before receiving his degree.

For the student who may desire the breadth of technical training which this course offers, but who wishes to specialize in either cotton or wool manufacturing, two options are offered. In these optional courses the student's entire textile time is devoted to the study of that particular fiber which he elects.

During the past few years a demand has come from the distributing or marketing branches of the textile business for men with a four years' technical training. With the idea of offering courses which may better prepare graduates to meet this new call, the new Sales Option Course is offered.

There are also requests for a four-year Design Course which, while majoring in Textile Design, includes other subjects that help to make a broader course than the one of three years' duration. For this purpose the Design Option Course is offered. Like the other courses outlined, these will be subject to changes to meet new demands.

For detailed description of subjects, see page 34.

Course VI.—Textile Engineering (General Course)

[For first year see page 19]

Second Year. First Term. (Hours of Exercise)

Cotton Yarn Manufacture F–20a	45	Textile Design and Cloth Analysis D–20, 21, or Language E–20	45
Machine Drawing B–21	60	Wool Yarn Manufacture G–20	120
Machine Shop B–23	90		
Mathematics B–20	60		
Physics B–22	75		
Textile Chemistry and Dyeing Lecture C–21	30		

Second Year. Second Term

Applied Mechanics B–25	45	Machine Drawing B–21	45
Advanced Textile Mechanism B–26, or Language E–20	45	Mathematics B–20	60
Cotton Yarn Manufacture F–20a	75	Physics B–22	75
		Power Weaving D–22	90
		Wool Yarn Manufacture G–20	90

Third Year. First Term

Applied Mechanics B–30	45	Power Weaving D–31	60
Cotton Yarn Manufacture F–30a	60	Wool Yarn Manufacture G–30	90
Economics E–30	45	Woolen and Worsted Finishing H–30	75
Electrical Engineering B–31	75		
Heat Engineering B–32	75		

Third Year. Second Term

Cotton Yarn Manufacture F–30a	60	Mill Engineering B–34	90
Economics E–30	45	Wool Yarn Manufacture G–30	90
Electrical Engineering B–31	75	Woolen and Worsted Finishing H–30	75
Heat Engineering B–33	90		

Fourth Year. First Term

Accounting B–40	90	Textile Marketing B–44	30
Cotton Organization F–32	90	Textile Testing G–31	30
Electrical Engineering B–41	75	Thesis	90
Microscopy B–43	45	Electives B–47	
Mill Engineering B–42	75		

Fourth Year. Second Term

Business Administration B–45	90	Mill Engineering B–42	75
Cotton Finishing H–31	105	Mill Illumination B–46	45
Electrical Engineering B–41	75	Thesis	105
Knitting F–31a	30	Electives B–47	

Course VI.—Textile Engineering (Cotton Option)

[For first year see page 19]

Second Year. First Term. (Hours of Exercise)

Cotton Yarn Manufacture F–20a	165	Textile Chemistry and Dyeing Lecture C–21	30
Machine Drawing B–21	105	Textile Design and Cloth Analysis D–20, or Language E–20	45
Machine Shop B–23	45		
Mathematics B–20	60		
Physics B–22	75		

Second Year. Second Term

Advanced Textile Mechanism B–26, or Language E–20	45	Cotton Yarn Manufacture F–20a	180
Applied Mechanics B–25	45	Mathematics B–20	60
		Physics B–22	75
		Power Weaving D–22	120

Third Year. First Term

Applied Mechanics B–30	45	Heat Engineering B–32	75
Cotton Finishing H–31	75	Power Weaving D–31	60
Cotton Yarn Manufacture F–30a	75	Textile Design and Cloth Analysis D–20	75
Economics E–30	45		
Electrical Engineering B–31	75		

Third Year. Second Term

Cotton Finishing H–31	75	Heat Engineering B–33	90
Cotton Yarn Manufacture F–30a	120	Mill Engineering B–34	90
Economics E–30	45	Textile Design and Cloth Analysis D–20	30
Electrical Engineering B–31	75		

Fourth Year. First Term

Accounting B–40	90	Textile Marketing B–44	30
Cotton Organization F–32	90	Textile Testing G–31	30
Electrical Engineering B–41	75	Thesis	105
Microscopy B–43	45	Electives B–47	
Mill Engineering B–42	30		
Textile Design and Cloth Analysis D–30	30		

Fourth Year. Second Term

Business Administration B-45	90	Textile Design and Cloth Analysis D–30	45
Electrical Engineering B–41	75	Thesis	105
Knitting F–31a	120	Electives B–47	
Mill Engineering B–42	45		
Mill Illumination B–46	45		

Course VI.—Textile Engineering (Wool Option)

[For first year see page 19]

Second Year. First Term. (Hours of Exercise)

Machine Drawing B-21	105
Machine Shop B-23	45
Mathematics B-20	60
Physics B-22	75
Textile Chemistry and Dyeing Lecture C-21	30
Textile Design and Cloth Analysis D-21, or Language E-20	45
Wool Yarn Manufacture G-20	165

Second Year. Second Term

Advanced Textile Mechanism B-26, or Language E-20	45
Applied Mechanics B-25	45
Mathematics B-20	60
Physics B-22	75
Power Weaving D-22	120
Wool Yarn Manufacture G-20	180

Third Year. First Term

Applied Mechanics B-30	45
Economics E-30	45
Electrical Engineering B-31	75
Heat Engineering B-32	75
Power Weaving D-31	60
Wool Yarn Manufacture G-30	150
Woolen and Worsted Finishing H-30	75

Third Year. Second Term

Economics E-30	45
Electrical Engineering B-31	75
Heat Engineering B-33	90
Mill Engineering B-34	90
Wool Yarn Manufacture G-30	150
Woolen and Worsted Finishing H-30	75

Fourth Year. First Term

Accounting B-40	90
Electrical Engineering B-41	75
Microscopy B-43	45
Mill Engineering B-42	30
Textile Design and Cloth Analysis D-30	120
Textile Marketing B-44	30
Textile Testing G-31	30
Thesis	105
Electives B-47	

Fourth Year. Second Term

Business Administration B-45	90
Electrical Engineering B-41	75
Knitting F-31a	30
Mill Engineering B-42	45
Textile Design and Cloth Analysis D-30	90
Thesis	150
Electives B-47	
Mill Illumination B-46	45

Course VI.—Textile Engineering (Design Option)

[For first year see page 19]

Second Year. First Term. (Hours of Exercise)

Cotton Yarn Manufacture F–20a	165	Textile Design and Cloth Analysis D–20, 21	150
Mathematics B–20	60	Language or Textile Design	45
Physics B–22	75		
Textile Chemistry and Dyeing Lecture C–21	30		

Second Year. Second Term

Advanced Mechanism B–26, or Language E–20	45	Power Weaving D–22	90
Cotton Yarn Manufacture F–20a	75	Textile Design and Cloth Analysis D–20, 21	90
Mathematics B–20	60	Wool Yarn Manufacture G–20	90
Physics B–22	75		

Third Year. First Term

Advanced Physics B–37	75	Wool Yarn Manufacture G–30	90
Economics E–30	45	Woolen and Worsted Finishing H–30	75
Power Weaving D–31	75		
Textile Design and Cloth Analysis D–30	165		

Third Year. Second Term

Economics E–30	45	Wool Yarn Manufacture G–30	90
Power Weaving D–31	105	Woolen and Worsted Finishing H–30	75
Textile Design and Cloth Analysis D–30	210		

Fourth Year. First Term

Accounting B–40	90	Textile Styling and Merchandising B–49	75
Jacquard Weaving	90	Textile Testing G-31	30
Microscopy B–43	45	Thesis	90
Textile Design and Cloth Analysis	75		
Textile Marketing B–44	30		

Fourth Year. Second Term

Business Administration B–45	90	Textile Design and Cloth Analysis	165
Cotton Finishing H–31	105	Thesis	90
Power Weaving	75		

Course VI.—Textile Engineering (Sales Option)

[For first year see page 19]

Second Year. First Term. (Hours of Exercise)

Cotton Yarn Manufacture F–20a	165	Textile Design and Cloth Analysis D–20, 21	150
Mathematics B–20	60	Language or Textile Design	45
Physics B–22	75		
Textile Chemistry and Dyeing Lecture C–21	30		

Second Year. Second Term

Advanced Mechanism B–26, or Language E–20	45	Power Weaving D–22	90
Cotton Yarn Manufacture F–20a	75	Textile Design and Cloth Analysis D–20, 21	90
Mathematics B–20	60	Wool Yarn Manufacture G–20	90
Physics B–22	75		

Third Year. First Term

Advanced Physics B–37	75	Wool Yarn Manufacture G–30	90
Economics E–30	45	Woolen and Worsted Finishing H–30	75
Power Weaving D–31	75		
Principles of Marketing B–35	45		
Textile Design and Cloth Analysis D–30	120		

Third Year. Second Term

Economics E–30	45	Wool Yarn Manufacture G–30	90
Power Weaving D–31	45	Woolen and Worsted Finishing H–30	75
Marketing Methods B–36	105		
Textile Design and Cloth Analysis D–30	165		

Fourth Year. First Term

Accounting B–40	90	Textile Styling and Merchandising B–49	75
Jacquard Weaving	90	Textile Testing G–31	30
Microscopy B–43	45	Thesis	90
Principles of Selling and Advertising B–48	105		

Fourth Year. Second Term

Business Administration B–45	90	Knitting F–31a	75
Cotton Finishing H–31	105	Selling Policies B–51	45
Foreign Trade and Economic Geography B–50	45	Statistics	45
		Thesis	120

SUBJECTS OF INSTRUCTION

TEXTILE ENGINEERING DEPARTMENT—B

Mathematics—B–10. Preparation: Admission Requirements. The work in the first term consists of plane trigonometry, logarithms, and instruction in the use of the slide-rule. Right and oblique triangles are solved by means of natural and logarithmic functions, and the various algebraic relations among the trigonometric functions are proved and used in identities and equations. Significant figures and the use of approximate data in calculations are also discussed.

In the second term the following topics are taken up: graphical and mathematical solution of quadratic and simultaneous equations, theory of equations, partial fractions, Naperian logarithms, equations of the straight line, equations of various curves, differentiation of algebraic functions, and applications of the derivative. [Course VI.]

Mathematics—B–10a. Preparation: Admission Requirements. This subject in the first term is identical with B–10. In the second term, the following topics are given: graphical solutions of equations, theory of equations, partial fractions, Naperian logarithms, and equations of the straight line and various curves. [Course IV.]

Mathematics—B–10b. Preparation: Admission Requirements. This subject in the first term is identical with B–10a but excludes some of the topics given in the second term of B–10a. [Courses I, II, III.]

Physics—B–11. Preparation: Admission Requirements. Taken simultaneously with B–10. This subject is required as a necessary preparation for all courses, and sixty hours of lecture and recitation time are devoted to it during the first term of the first year. The fundamental principles of this subject are considered absolutely essential to a thorough understanding of the operation of all machinery, textile or otherwise. Some of the topics treated in this course are linear and angular velocity, uniform and accelerated motion, mass, momentum, inertia, effect of force in producing motion, centrifugal force, work, power, energy, principle of moments and its applications, parallelogram and triangle of forces with applications, resolution and composition of forces, the mechanical principles represented by the wheel and axle, differential pulley block, common pulley blocks, jackscrew, worm and wheel, and inclined plane.

Laboratory

This course is supplementary to the lecture course and gives the student an opportunity to apply the knowledge gained in the lecture course by performing various experiments. [All courses.]

Mechanism—B–12. Preparation: B–10 and B–11. This subject is also deemed to be one of those absolutely essential to every student's preparation for the work of the following years. Whereas the principles studied are of general application, textile machinery in particular furnishes an unusually large variety of specific examples, and frequent reference is made to these in the development of the course. Some of the important topics covered are gearing and gear train design, belting and pulley calculations, cone and stepped pulley design, cam design, linkages, epicyclic gear trains, and intermittent motion devices.

Laboratory

This work is supplementary to the course in Mechanism. Some of the experiments and tests made in this course are as follows:—

Determination of coefficient of friction; proof of principle of work; efficiency test of various hoisting and lifting appliances, such as tackle and fall, worm block, differential and triplex blocks, jackscrews, wedges, etc.; efficiency tests on belt transmission, including measurement of belt tensions, coefficient of friction, slip, etc. [Courses I, II, III, VI.]

Mechanism—B–12a. Preparation: B–10 and B–11. This course is similar in content to Mechanism B–12. The material has been revised and reduced so as to fit more nearly the needs of the students taking Course IV. No laboratory is given with this course. [Course IV.]

Mechanical Drawing—B-13. Preparation: Admission Requirements. Taken simultaneously with B-11. This course is taken during the first year, and consists of work in the drawing room supplemented by lectures. This subject is considered of the greatest importance as a preparation for the student's future work, and the practical usefulness of drawing of this character is fully emphasized. The course is systematically laid out covering in order the following divisions:—

Care and use of drawing instruments; geometrical constructions; lettering; elements of projections and descriptive geometry; isometric projection; developments with practical applications; sketching practice on machine details. [All courses.]

Machine Drawing—B-14. Preparation: B-13. This course is the continuation of Mechanical Drawing, and is pursued throughout the second term of the first year. The work is wholly of a practical character, and includes sketching from the textile machinery details and working scale details, tracing and blue-printing. The rudiments of machine design to supplement the work in strength of materials are also given. [Course VI.]

Machine Drawing—B-14a. Preparation: B-13. This course is similar to B-14, but not so extensive, and is given to students electing the manufacturing courses. [Courses I, II, III.]

Mathematics—B-20. Preparation: B-10. This subject is a continuation of the first year subject B-10, and extends throughout the second year of the engineering course. In the first term the following topics are treated:—derivatives and differentials, the circle, parabola, ellipse, hyperbola, indefinite integrals, summation by integration and applications of integration. In the second term the topics are: differentiation of transcendental functions, methods of integration, centers of gravity, moments of inertia, empirical formulas, and nomographic charts. [Course VI.]

Mathematics—B-20a. Preparation: B-10a. This subject is a continuation of the work of the first-year subject B-10a. A study of the derivative is followed by the differentiation of algebraic functions and applications of the derivative to maximum and minimum and rate problems. Other topics treated are the circle, parabola, ellipse, hyperbola, indefinite integrals, summation by integration, areas, volumes and pressures. [Course IV.]

Machine Drawing—B-21. Preparation: B-13. The work in Machine Drawing is devoted to working detail drawings of textile machinery and advanced graphical mechanism problems. The data for all of these problems are in every case taken directly from some of the textile machines that the students meet in other departments. [Course VI.]

Physics—B-22. Preparation: B-10 and B-11. This subject lays the foundation for later work in engineering and chemistry and also explains the general application of the laws and principles of physics. Instruction, consisting of lectures, demonstrations, and recitations, is given for three hours per week during the second year. The topics taken up the first term are:—thermometry, measurement of heat, change of state, expansion, transfer of heat, humidity, hydrostatics, elements of hydraulics, the vernier, kinetic energy, circular motion, harmonic motion, wave motion and sound.

The second term is devoted to the study of light, magnetism, and electricity. Some of the topics are:—nature and propagation of light, reflection and refraction lenses, the telescope and microscope, the spectroscope, color sensation, double refraction, magnetism, electrostatics, fundamental laws of direct currents and electrolysis.

Laboratory

Laboratory work consisting of a two-hour period per week accompanies the class work in this subject and is planned to illustrate precise methods for measuring various physical quantities. [Course VI.]

Physics—B-22a. Preparation: B-10a and B-11. This subject consists of the same topics as B-22 but does not contain any laboratory work. [Courses I, II, III, IV.]

Machine Shop Practice—B-23. Preparation; B-11 and B-12. Systematic instruction is given in the most approved methods of machine shop practice, the

object being to familiarize the student with the proper use of hand and machine tools, and the characteristics of the different materials worked. Particular attention is given to the form, setting, grinding and tempering of tools and the mechanism of the different machines involving certain speeds, feeds, etc. The course is so planned that the instruction in each typical operation shall conform as nearly as possible to commercial machine-shop practice on textile machinery. The list of tools which appears under "Equipment" in this Bulletin gives an idea of the scope of the work, which includes chipping and filing, tool grinding and tempering, straight and taper turning, screw cutting, drilling and boring, planer work; milling machine work, including gear cutting. [Course VI.]

Steam Engineering—B-24. Preparation: B-10, B-11, B-12. This course consists of thirty lectures given in the first term of the second year. Its aim is to give those students who do not take the Engineering Course a general knowledge of thermodynamics, the steam engine, steam turbine and gas engine and their auxiliaries, and waste heat reclamation. [Courses I, II, III, IV.]

Applied Mechanics—B-25. Preparation: B-10, B-11, B-20. This course is divided into two parts: Graphic Statics and Strength of Materials. The first eight weeks of the semester which is devoted to Graphic Statics consists of the study of mathematical and graphical solutions for any system of forces. Centers of gravity and funicular polygons are introduced followed by roof and bridge truss problems under various conditions of dead, live, wind, and snow loading.

During the second half of the semester and during all the following semester, this course deals with Strength of Materials. So far as time permits, such topics as stress, strain, methods of testing materials, bending moments, shearing force, beam design, torsion, design of shafts, compound beams and columns, combined stresses, and like subjects, are considered.

This subject is preparatory to the work in Mill Engineering of both the third and fourth years, at which time its practical value and application are clearly demonstrated. [Course VI.]

Advanced Textile Mechanism—B-26. Preparation: B-12, B-20. B-21. The first part of this course is a continuation of the elementary course in Mechanism (B-12); the second part takes up the study of the more complicated mechanisms used in textile machinery. Methods of mathematical and graphical analysis are applied to existing textile mechanisms, and problems of design are also included. [Course VI.]

Applied Mechanics—B-30. Preparation: B-25. This is a continuation of applied Mechanics B-25, and is given during the first term of the third year. [Course VI.]

Electrical Engineering—B-31. Preparation: B-22. The elementary principles of electricity and magnetism are considered in the lecture course of physics. Their development and application are taken up in this course in a detailed study of the magnetic and electric circuits during the first period of the first term. The second period is devoted to a study of the principles of direct current machinery. The laboratory work consists of a study of technical electrical measurements and dynamo-electric machinery, determining for the latter their operating characteristics.

The second term is devoted entirely to a study of the principles of alternating current circuits, including vector representation, effective values, power, series and parallel circuits. The laboratory work consists of a study of technical electrical measurements, some meter calibration including that of watt-hour meters and a study of alternating current circuits using electrical measuring instruments. [Course VI.]

Electricity—B-31a. Preparation: B-22a. This is a short course given in the third year of the manufacturing courses, and consists of thirty lectures covering briefly and in a general way the theory of direct and alternating current generators and motors. [Courses I, II, III.]

Heat Engineering—B-32. Preparation: B-10, B-11, B-12, B-20. The purpose of this course is to familiarize the student with the principles of elementary thermodynamics, the properties of steam, mechanical mixtures and combustion of fuels. The course consists of thirty exercises given in the first term of the third

year. The lectures and recitations are supplemented with illustrative problems assigned for home preparation.

LABORATORY

The principles underlying the subjects of steam engineering, hydraulics and thermodynamics are demonstrated in a practical manner in the work in the Engineering Laboratory, given three hours per week. Greater importance is attached to the development of initiative and responsibility in the student than the mere accomplishment of a large number of carefully planned tests. The character of this work is indicated by the following list of experiments and tests:—

Calibration of scales, tanks, gauges, inductors and counters; barrel, separating, and throttling calorimeter tests; heat exchange tests; boiler inspection and measurement; flue gas analysis; dynamometer tests; ejector and injector tests; Rankin's efficiency, actual thermal efficiency and duty tests; expansion of pipes, radiation and pipe covering tests; boiler test; trap tests, feed water heating tests; steam, triplex and centrifugal pump tests. [Course VI.]

Heat Engineering—B–33. Preparation: B–32. This course is a continuation of B–32, and consists of forty-five hours of lectures and recitations given in the second term of the third year of the Textile Engineering course. The subjects developed are the kinematics of reciprocating steam engines, steam turbines and gas engines. Special attention is given to the mechanical principles on which the steam engine operates, with detail discussion of the valve gear and governing devices, and the various diagrams used for studying the same. Consideration is given to the underlying heat theory and to the details of construction of the various parts of the machines. During the latter part of the course the historical development, classification and types of turbines and gas engines are discussed.

LABORATORY

The character of the work in the Engineering Laboratory, given three hours per week during the second half of the third year, is indicated by the following list of experiments:—

Boiler inspection and measurement; Rankin's efficiency, actual thermal efficiency and duty tests; boiler test; valve setting by measurement and by indicator; condenser test; non-condensing and condensing engine and turbine tests; heating and ventilating fan tests; lap and butt riveted joint test; nozzle test; gas engine test; flow of air and air compressor tests. [Course VI.]

Mill Engineering—B–34. Preparation: B–12, B–20, B–21, B–25. Mill Engineering, as presented in thirty lectures during the third year of the Textile Engineering course, consists of a discussion of the following topics: the selection of a site for a manufacturing plant; the investigation of the subsoils for the footing course of the foundation; wood; concrete and sheet steel piling; design of walls, beams, floors, windows, doors, stairways and roofs.

Sixty hours of drawing-room and laboratory practice are devoted to plane surveying, contour plotting, cut and fill calculations, setting of batter boards, alignments of shafting and the study from blue-prints of slow-burning construction. [Course VI.]

Mill Engineering—B–34a. Preparation: B–10, B–12, B–21. Mill Engineering, as presented in thirty lectures during the third year of the diploma courses, is largely general in its nature and includes only parts of Course B–34. [Courses I, II, III.]

Principles of Marketing—B–35. An introduction to the basic principles underlying the modern systems of distributing goods with special emphasis on the raw and finished products of the textile industry. The course will cover the history and economic importance and functions in modern distribution of the selling agent, the commission man, the broker, jobber, merchant, factor and other intermediaries as well as the channels that goods may take from the producer to the ultimate consumer. The importance and advantages of each will be studied with special emphasis on the present practice and trends in the textile industry.

Lectures and the case method of instruction will be employed.

Marketing Methods—B–36. Preparation: B–35. A continuation of the Principles of Marketing. The course will be conducted by means of lectures and

case problems and discussions. Some of the subjects studied in detail are,—the planning of marketing campaigns, the fluctuations of price and style, forecasting, the business cycle, quotas, market surveys and research, sales planning and control, industrial marketing, and consumer merchandising.

Considerable time will be devoted to the study of current literature and events in the textile field.

Textile Physics—B-37. Preparation: B-11, B-22. The work in this subject consists of experimental determinations of the physical properties of textile fibers, yarns and fabrics. Special emphasis is placed upon the study of properties which determine the color characteristics of textile materials. [Course VI, Design and Sales Options.]

Accounting—B-40. Preparation: B-10 and E-30. The purpose of the course in accounting is to acquaint the student with modern methods of accounting for mercantile and manufacturing businesses. At the same time it gives him a much-needed knowledge of such common elementary business transactions as are involved in the use of checks, drafts, notes, vouchers, bonds and stocks.

It is not the purpose of the course to make the student a proficient bookkeeper or accountant, but the nature of the work necessitates a basic knowledge of double-entry bookkeeping and of the functions of ledger accounts. This is developed in practice in the following manner: During the summer preceding the fourth year the student is required to work up a simple bookkeeping set, thus saving valuable time during the school year and effectively preparing the ground for the instruction work.

The course includes a study of the balance sheet and profit and loss statement, and their construction in proper form. Attention is given to the principles of balance sheet valuation, and to such topics as depreciation in all its phases, sinking fund reserves, and the accounting for bond and stock issues.

One-half of the time scheduled for accounting is devoted to a study of Cost Accounting. It is designed to give the student a knowledge of the best cost methods in use at the present time, and involves a thorough discussion of methods of handling and accounting for raw materials, direct labor, and the distribution of overhead expenses. [Course VI.]

Electrical Engineering—B-41. Preparation: B-31. During the first term a detailed study of the alternator is made, with particular stress on generation of three-phase currents. Methods of predetermination of alternator regulation are taken up and at least one method compared with laboratory test. Parallel operation of alternators with acccompanying instruments and devices are studied in classroom and laboratory. The single phase, three-phase and Scott transformers are considered in turn and their various methods of connecting to line and alternators are systematically studied.

In the second term the induction motor and generator are studied with their particular adaptability to the textile industry. The principal starting devices for this motor are thoroughly taken up. The synchronous motor is studied particularly in relation to its ability to correct power factor. In all the work outlined above, the main features are illustrated profusely in classroom demonstrations and laboratory exercises.

Mill Engineering—B-42. Preparation: B-11, B-12, B-21, B-23. This work, given in the fourth year of the Textile Engineering course, covers a wide range of subjects and is of the most practical character possible. All of the student's previous work in engineering and his knowledge of the textile processes are here brought together in the consideration of the larger problems of mill design, construction and organization. After a detailed study has been made of the most modern types of mill buildings, including all calculations and drawings, the student is given the problem of laying out and completely designing a textile mill so far as time permits.

The modern methods of power transmission and the proper arrangement of textile machinery are also given careful consideration. The problems are in every case taken from actual conditions in mills already built or in process of construction. The question of mill heating, ventilation, lighting, humidification and fire protection is also studied, and the time spent in the drawing room enables the student to work

out nearly all of the more important problems involved in the design of an entire textile mill plant. The close relation existing between proper plant design and economical production is also considered. [Course VI.]

Microscopy—B-43. Preparation: B-22. This subject consists of the study of animal and vegetable fibres by means of the microscope and its accessories. It includes sectioning and mounting, measurements of diameter and twist, and the use of polarized light in the study and identification of fibers. [Course VI.]

Textile Marketing—B-44. This subject covers the problems of marketing textile products, with particular emphasis upon the ultimate consumer. The course will survey the principal marketing channels and marketing methods. Attention is directed to the possibilities of demand creation and demand control, especially through market and style research. Current changes in marketing organization of the industry will be studied and reviewed. [Courses IV and VI.]

Business Administration—B-45. Preparation: B-10 and E-30. In recognition of the great advances which have been recently made towards better methods of management, and of the possibilities which may result from its application to the textile industry, a course in business administration has been established to enable the student to understand and apply the principles and details of modern management. The instruction in this course begins with a consideration of the factory location and design and their effect on efficiency of production, after which the proper form of organization for manufacturing establishments is discussed in detail, together with organization charts and records.

This is followed by a study of the details of the work of the various departments, such as purchasing, manufacturing, planning, etc., and includes such topics as purchasing systems, storekeeping, perpetual inventories, warehousing, scheduling, routing, tracing, timekeeping, motion studies, time studies, mnemonic symbolizing, graphical records, wage systems, etc. Consideration is also given to the important relation of psychology to efficient management. The work is further supplemented by visits to plants where methods of production and management can be observed at first hand by the students.

Business Law

Under this subject are given lectures, supplemented by the use of a suitable text, on the law governing contracts, negotiable instruments, sales, bills of lading, real estate and corporation. [Course VI.]

Mill Illumination—B-46. Preparation: B-22. Because of the demand and the necessity for proper lighting of textile mills, this course is offered three hours per week for one term. It consists of three major parts,—photometry, illumination and installation design. Costs and estimates, safety and production, are included.

The laboratory exercises include the study and applications of the photometer, Macbeth Illuminometer and foot-candle meter. The concluding work is a design of a lighting installation for a typical mill room, using the school laboratories for this purpose. [Course VI.]

Electives—B-47. Students in the fourth year of the Textile Engineering course will be permitted to elect certain textile subjects as substitutes for part of the time scheduled for engineering subjects. Thus a student is offered an opportunity for specialized study along such lines as will prove most beneficial to him at that time. The selection of elective studies is subject to the approval of the head of the Textile Engineering department and to the possibility of arranging for the same. [Course VI.]

Principles of Selling and Advertising—B-48. A comprehensive course dealing with the fundamental principles of advertising and selling. The course will cover the psychology of selling and advertising, the legal restrictions in marketing, advertising technique, copy writing, layout, illustrations, advertising campaigns, packaging, advertising mediums, industrial and consumer advertising, creative salesmanship personality, types of customers, the selling process, supersalesmanship, etc.

Lectures and the case method of instruction will be used. [Course VI, Sales Option.]

Textile Styling and Merchandising—B–49. This course will correlate the technical knowledge of design, acquired previously, to the fluctuations of style design, the creation of fads and the forecasting and planning of styles.

The methods of merchandising textiles and the manner and form of presenting them to the ultimate consumer will be studied in detail. [Course VI, Sales Option.]

Foreign Trade and Economic Geography—B–50. The course will cover the foreign markets for finished textiles and the American raw fibres, methods of selling employed and foreign commercial law that an American exporter needs. Also the foreign fibers and textiles and their importance in international trade.

Special emphasis will be given upon costs of foreign marketing, tariffs, international competition, possible markets and methods of building an export business. [Course VI, Sales Option.]

Selling Policies—B–51. This course will cover the development of administrative policies and guiding principles in the marketing, pricing, styling and merchandising of textiles and textile fibers. [Course VI, Sales Option.]

CHEMISTRY AND DYEING DEPARTMENT—C

Elementary Chemistry (Inorganic and Organic Chemistry)—C–10. Preparation: Admission Requirements. Instruction in Elementary Chemistry extends through the first year, and includes lectures, recitations and a large amount of individual laboratory work on the following subjects:—

Inorganic Chemistry

Non-Metallic Elements.—Their occurrence, properties, preparation, chemical compounds, etc.

Metallic Elements.—Their occurrence, properties, metallurgy, chemical compounds, etc.

Theoretical Chemistry.—Fundamental laws and the theories of chemistry including chemical action, chemical combination, combining weights, atomic weights, chemical equations, acids, bases, salts, Avogadro's law, molecular weights, formulæ, valence, periodic law, etc.

Throughout this course special attention is given to the relationship which exists between the science of chemistry and the properties of the materials used in the various industries and the chemical reactions depended upon for the maintenance of industrial processes.

The laboratory work of this course includes the experimental study of the above subjects and also a preliminary study of the qualitative detection of the more common metals and non-metals, preparatory to Course C–13.

Organic Chemistry

This course includes a general survey of the fundamental principles of Organic Chemistry, also a study of the hydrocarbons and their derivatives from the point of view of their structure, preparation and uses. This work, although elementary in character, is of sufficient breadth to prepare the student understandingly for the general lectures upon Coal Tar dyestuffs which are given in Course C–21.

Chemical Technology of Fibers—C–11. The outline of the lecture course which is given during the second term of the first year is as follows:—

Technology of Vegetable Fibers.—Cotton, linen, jute, hemp, china grass. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Animal Fibers.—Wool, mohair, silk. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Artificial Fibers.—Study of the various forms of artificial silk, the process cf manufacture, their properties and action with chemicals, acids and heat. [All courses.]

Textile Chemistry—C–12. This is a lecture course of one hour per week given during the second term of the first year.

Operations Preliminary to Dyeing.—Bleaching of cotton and linen; wool-scouring; bleaching, fulling and felting of wool; carbonizing; silk-scouring and bleaching; action of soap.

The bleaching of cotton cloth, yarn and raw stock is studied at length with detailed description of the various forms of kiers and machinery used; also the action of the chemicals used upon the material, and the various precautions that must be taken in order to insure successful work.

Under this heading is also included an exhaustive study of the reagents used in the emulsive wool-scouring process, and their action upon the fiber under various conditions; also the most successful of the solvent methods for degreasing wool.

Water and its Application in the Textile Industry.—Impurities present, methods for detection, their effect during the different operations of bleaching, scouring, dyeing and printing, and the methods used for their removal or correction.

The important subject of boiler waters is also studied under this heading, with a full discussion of the formation of boiler scale, its disastrous results, and the methods by which it may be prevented. [All courses.]

Qualitative Analysis—C–13. Preparation: C–10, taken simultaneously. Qualitative Analysis is studied during the second term of the first year. The work consists of conferences and laboratory work. The student must become familiar with the separations and the detections of the common metals and acids by the analysis of a satisfactory number of solutions, salts, alloys and pigments. At intervals during the term short laboratory tests are given as well as the regular written examinations.

No pains are spared to make the course as valuable to the student as possible, and to encourage only thorough and intelligent work.

When sufficiently advanced, students take up the examination of various products with which the textile chemist must be familiar such as testing mordanted cloths, pigments and the various dyeing reagents.

During the latter part of this course a certain amount of time is devoted to the preliminary operations of quantitative analysis, such as the precipitation and washing of such substances as barium sulphate, magnesium ammonium phosphate and calcium oxalate, although no weighings or actual determinations are made.

A student's marks in this subject depend as much upon the neatness and care used in manipulation as upon the actual results obtained. [Course IV.]

Stoichiometry—C–14. Preparation: B–10, C–10. This subject is taken two hours each week during the second half of the first year. The application of the metric system is thoroughly studied, and problems are worked involving the expansion and contraction of gases, determination of empirical formulæ, combining volume of gases and chemical calculations, especially those of quantitative analysis. [Course IV.]

Stoichiometry—C–20. Preparation: C–14. This is a continuation of Stoichiometry C–14, and is taken during the second year as an adjunct to Quantitative Analysis. [Course IV.]

Textile Chemistry and Dyeing—C–21. Preparation: C–10, B–12, B–14. Mordants and Other Chemical Compounds Used in Textile Coloring and Classified as Dyestuffs.—Theory of mordants, their chemical properties and application, aluminum mordants, iron mordants, tin mordants, chromium mordants, organic mordants, tannin materials, soluble oil, fixing agents, leveling agents, assistants, and numerous other compounds, not dyestuffs, that are extensively used in the textile industry.

Under this heading are included the definitions of various terms and classes of compounds used by textile colorists, such as color lakes, pigments, fixing agents, developing agents, mordanting assistants, mordanting principles and leveling agents.

Theory of Dyeing.—A discussion of the chemical, mechanical, solution and absorption theories, and the various views that have been advanced by different investigators of the chemistry and physics of textile coloring processes.

Under this heading are discussed the general methods of classifying dyestuffs and the definitions of such terms as textile coloring, dyeing, textile printing, substantive and adjective dyestuffs, monogenetic and polygenetic dyestuffs.

Natural Organic Coloring Matters.—Properties and application of indigo, logwood, catechu or cutch, Brazil wood, cochineal, fustic, tumeric, madder, quer-

citron bark, Persian berries, and other natural dyestuffs that have been used within recent years by textile colorists.

Mineral Coloring Matters.—Under this heading are discussed the properties of such inorganic coloring matters and pigments as chrome yellow, orange and green, Prussian blue, manganese brown and iron buff.

Artificial Coloring Matters.—General discussion of their history, nature, source, methods of manufacture, methods of classification and their application to all fibers.

Special study of basic coloring matters, phthalic anhydride colors, including the eosins and phloxines; acid dyestuffs, Janus, direct cotton, sulphur and mordant colors, including the alizarines and other artificial coloring matter requiring metallic mordants; mordant acid and insoluble azo colors, developed on the fiber; reduction vat colors, aniline black and other artificial dyestuffs not coming under the above heads.

As each class of dyestuffs is taken up, the details of the methods of applying them upon all the different classes of fabrics and in all the different forms of dyeing machines are thoroughly discussed; also the difficulties which may arise in their application, and the methods adopted for overcoming them.

Machinery Used in Dyeing.—A certain amount of time is devoted to the description of the machinery used in various processes of textile coloring which is supplemented as far as possible by the use of charts, diagrams and lantern slides.

Most of the important types of dyeing machines are installed within the dyehouse of the school, and the students can be taken directly from the lecture room and shown the machines in actual operation. [All courses.]

Dyeing Laboratory—C–22. Preparation: C–21 taken simultaneously. Besides lectures and recitations upon the subject of Textile Chemistry and Dyeing, practical laboratory work is required. By the performance of careful and systematic experiments the student learns the nature of the various dyestuffs and mordants, their coloring properties, their action under various circumstances, and the conditions under which they give the best results. The more representative dyestuffs of each class are applied to cotton, wool and silk, and each student is obliged to enter, in an especially arranged sample book, a specimen of each of his dye trials with full particulars as to the conditions of experiment, percentage of compounds used, time, temperature of dye bath, etc.

For convenience and economy most of the dye trials are made upon small skeins or swatches of the required materials, but from time to time students are required to dye larger quantities in the full-sized dyeing machines which are described elsewhere.

By the use of a small printing machine the principles of calico printing are illustrated, and by means of the full-sized dyeing machines and vats the practical side of the subject is studied. It is the constant endeavor of those in charge to impart information of a theoretical and scientific character that will be of value in the operation of a dyehouse. [Course IV.]

Advanced Inorganic Chemistry—C–23. Preparation: C–10. The whole subject of Inorganic Chemistry is reviewed during the second year, and many advanced topics are introduced which were necessarily omitted from the first-year course in General Chemistry. [Course IV.]

Advanced Organic Chemistry—C–24. Preparation: C–10. In this course, which consists of lectures and recitations, the principles of organic substitution and synthesis are thoroughly discussed and as many illustrations are used as time will permit, particularly such as are applied in the arts. The aliphatic series of hydrocarbons and their derivatives are studied for about twenty weeks, the remainder of the time being devoted to the benzine series. The aim of the course is to lay a broad foundation for the study of the chemistry of the artificial dyestuffs. Students are required to work out problems in the synthesis of various compounds, in order to become familiarized with equation writing. [Course IV.]

Quantitative Analysis—C–25. Preparation: C–13, C–14. The object of this course is to teach the fundamental principles of quantitative analysis, and to give the student an opportunity of acquiring skill in manipulating the special apparatus used in analytical procedure.

Typical gravimetric methods are taught the first term. The samples analyzed comprise salts, minerals and ores. Electrochemical analysis is carried out with the aid of a modern type of apparatus designed for rapid work.

The work of the second term consists of volumetric methods. A number of ores and commercial products, carefully chosen, are analyzed so as to give the student a varied experience.

The laboratory work is supplemented by lectures and recitations. Smith's "Quantitative Chemical Analysis" is used as a text. [Course IV.]

Quantitative Analysis—C-30. Preparation: C-25. The fundamental principles acquired in Course C-25 are applied in this course in the examination of materials used in the textile mill, the dyehouse, and the finishing plant. Among the materials analyzed are water, soaps, oils, textile fabrics, stripping agents, acids and alkalies. The latest and most practical methods are employed. Griffin's "Methods of Technical Analysis" is used as a text. [Course IV.]

Industrial Chemistry (Lecture)—C-31. Preparation: C-23, C-24. During the whole of the third year lectures and recitations are held in industrial chemistry, the course in general following Roger's "Manual of Industrial Chemistry." Particular attention is paid to those subjects which are of special interest to the textile chemist, as oils, soaps, gas and coal-tar industry, building materials, and the manufacture on a large scale of important chemical compounds, such as the common acids and alkalies, bleaching powders, various mordants, etc. The course is illustrated as far as possible with specimens, diagrams and charts, and the students are given an opportunity to visit some of the industrial establishments in the vicinity of Lowell and Boston. [Course IV.]

Advanced Textile Chemistry and Dyeing—C-32. Preparation: C-21, C-22. This is a continuation of the Textile Chemistry and Dyeing course of the second year, and includes a review of the second year's work in this subject, with the introduction of many advanced considerations, and, in addition, the following subjects:—

Classification and Construction of Artificial Dyestuffs.—A study from a more advanced standpoint of the classification and constitution of artificial dyestuffs including the various methods used in their production, also the orientation of the various groups which are characteristic of these compounds and their effect on the tinctorial power of dyestuffs.

The object of this study is to give the student a more complete knowledge of the artificial dyestuffs from the color manufacturer's point of view, which will prove of particular value to those who intend later to enter the employ of dyestuff manufacturers or dealers.

Color Matching and Color Combining.—A study of that portion of physics which deals with color and the many color phenomena of interest to the textile colorist. The lecture work is supplemented with the practical application of the spectroscope and tintometer, and much practice in the matching of dyed samples of textile material.

The primary colors both of the scientist and textile colorist, the results of combining coloring lights and pigments, and such subjects as color perception, color contrast, purity of color, luminosity, hue, color blindness, dichroism, fluorescence and the effect of different kinds upon dyed fabrics, are discussed under this heading.

Each student's eyes are tested for color blindness early in the course, in order that he may be given an opportunity to change his course if his eyes should prove defective enough to interfere with his work as a textile colorist.

A dark room has been provided where various experiments in color work and color matching may be performed.

Dye Testing.—This subject includes the testing of several dyestuffs of each class, subjecting them to the common, color-destroying agencies; the determining of their characteristic properties, and their action towards the different fibers; also the determining of the actual money value and coloring power of dyestuffs in terms of a known standard.

Each student is required to make a record of each color tested upon an especially prepared card, which furnishes a permanent record of all dyestuffs, their dyeing

properties, fastness to light and weather, washing, soaping, fulling, perspiration, bleaching, steaming, ironing, rubbing, acids and alkalies.

Union Dyeing.—A study of the principles involved in the dyeing of cotton and wool, cotton and silk, and silk and wool union materials in the production of solid and two-color effects.

Textile Printing.—A thorough study of the whole subject of textile printing, each student being required to produce individually no less than twenty different prints, including the following styles; pigment style, direct printing style, steam style with tannin mordant, steam style with metallic mordant, madder or dyed style, the ingrain or developed azo style, discharge dye style, discharge mordanted style, resist style, indigo printing, aniline black printing.

The different parts of the calico printing machine are thoroughly studied; also the precautions which must be considered in its use, and the arrangement of the dyeing apparatus which must accompany such a machine.

Special attention is paid to the methods of mixing and preparing the various color printing pastes that are used in the above work upon a manufacturing scale as well as experimentally in the laboratory.

Cotton Finishing.—A study of the various processes of finishing cotton cloth and the different materials used therein. The work involves the discussion of the various objects of cotton finishing and such operations as pasting, damping, calendering, stretching, stiffening, mercerizing, beetling and filling, and the various machines used for carrying out these processes.

Mill Visits.—During the third and fourth years visits are made to some of the large dyehouses, bleacheries and print works in the vicinity. [Course IV.]

Physical Chemistry—C–33. Preparation: B–20a, B–22, C–23, C–24. Two hours of lectures and recitations per week are given during the second term of the third year and throughout the fourth year. This subject includes a study of the fundamental laws and theories of chemistry, and the application of physical measurements to chemistry with illustrative problems. Special attention is given to textile applications. [Course IV.]

Advanced Organic Chemistry—C–34. Preparation: C–24. This is a continuation of Advanced Organic Chemistry C–24. [Course IV.]

Technical German—C–35. Preparation: E–21, C–21, C–23, C–24. This course consists of the reading of German technical literature, with the object of familiarizing the student with the current German publications in textile chemistry and coloring. [Course IV.]

Organic Chemistry Laboratory—C–36. Preparation: C–21, C–23, C–24, C–25. This course, while including practice in the usual methods of organic analysis, and giving excellent training in the principles and manipulations of general organic synthesis, is especially devoted to the synthetic dyestuffs. The student not only prepares many of the representative dyestuffs, but, what is far more important, he carries out all the operations, beginning with coal tar itself. Thus, instead of merely coupling two or more of the foreign imported intermediate products to make a dyestuff, he starts with the basic substances obtained from the coal tar and makes his own intermediate products. As far as is possible the student will be made acquainted with the problems which might arise in a dyestuff factory, and an excellent opportunity is presented for original work. [Course IV.]

Technical German—C–40. Preparation: C–35. This is a continuation of Technical German C–35. [Course IV.]

Organic Chemistry Laboratory—C–41. Preparation: C–34. This is a continuation of Organic Chemistry Laboratory C–34. [Course IV.]

Engineering Chemistry—C–42. Preparation: C–23, C–24, C–25. A series of lectures is given upon the general subject of Engineering Chemistry, which includes particularly the consideration of fuels, oils and water from the chemical engineer's standpoint. The elements of chemical engineering are also considered to such an extent as time will permit. [Course IV.]

Engineering Chemistry Laboratory—C–43. Preparation: C–25. The lectures in Engineering Chemistry are very adequately supplemented by work in the Engineering Chemistry Laboratory, which is thoroughly equipped with the latest and best apparatus for the testing of fuels, flue gases, and lubricating materials. [Course IV.]

Physical Chemistry—C-44. Preparation: C-33. This is a continuation of Physical Chemistry C-33. [Course IV.]

Advanced Textile Chemistry and Dyeing—C-45. Preparation: C-32. This is a continuation of the third-year work in Advanced Textile Chemistry and Dyeing, and includes the following subjects:—

Advanced Organic Chemistry (Dyestuffs). Advanced study of the coal-tar coloring matters, their chemistry, relations of their compositions to their coloring power, and the chemistry of their preparation.

Economics of the Dyeing, Bleaching and Finishing Industries.—A study of the factors to be considered in the establishment of a dyeing, bleaching and finishing plant together with the most essential considerations of its management.

Advanced Dyeing Conference.—During the latter part of his course each student will be required to write, for presentation before the other members of his class, a paper upon some assigned subject of general interest. After presentation the subject will be open to discussion and question.

The object of this conference is twofold. First, to give the student experience and practice in systematically looking up an assigned subject and presenting it before others; and secondly, to bring before the class a greater variety of subjects with more detail than could be covered by the general lectures of the course.

The Chemistry of Rayon, its Manufacture, Bleaching, Dyeing and Finishing.—During the past five years the developments of the bleaching, dyeing and finishing of rayon have been systematically studied and the curriculum of the Chemistry and Dyeing course has been revised from time to time to cover the latest developments in regard to these fibers. There is being installed at the present time a complete unit for the actual manufacture of different types of rayon, and with this available for experimental and demonstration purposes, it is anticipated that during the coming year instruction upon the production and subsequent treatment of rayon will be greatly amplified.

Many of the difficulties which arose during the early days of the artificial silk industry were due to lack of knowledge of its properties and more or less persistent attempts to handle it in just the same manner as real silk. As soon as the textile manufacturer began to fully appreciate the fact that the various rayons were entirely different fibers from true silk and consequently must be handled by different methods, then many extensive improvements were made in the processes of manufacturing textiles containing these fibers. In order to satisfactorily handle the different rayons they must receive a preliminary treatment with various oils and softeners, and as a result the problem of establishing the specifications for the best type of oil to use for this purpose and also the best methods of removing it from the material during the finishing process have been important problems in the development of the industry, and these among others are being studied in the Lowell Textile Institute at the present time. [Course IV.]

Photography—C-46. Preparation: B-22, C-21, C-23, C-24, C-25, Photography is today indispensable to the scientist and textile chemist. Without the aid of photography he cannot preserve and keep an absolute and accurate record of his investigations and research problems.

The Institute therefore offers to the Senior Chemists an eight-week course in the elements of Photography. One object of this course is to provide the student with the preliminary knowledge and training necessary for the course in Microscopy and Photomicrography which follows.

The course includes a study of the different types of cameras and lenses, the making of contact prints from classified negatives using various grades of papers, reduction and intensification of negatives, enlarging, copying, negative making and lantern slide preparation.

The theory and chemistry of the above subjects are not only covered in the classroom but in addition all of this work is actually carried on by each individual student in the Photographic Laboratory and Dark Room. [Course IV.]

Microscopy and Photomicroscopy—C-47. Preparation: B-22, C-21, C-23, C-24, C-25, C-46. The value of the microscope in the identification of textile materials and the examination of textile yarns and fabrics cannot be over-

estimated. In conjunction with photomicroscopy a permanent record which may be filed for future reference and which is understandable by non-technical men is obtained.

In this course the students are given instruction in the use and construction of various types of microscopes and accessories; the preparation and mounting of samples; the identification of starches and fibers; microchemical reactions; and examination of fabrics for faults. Actual unknown fibers, starches and fabrics are examined and reported upon.

Following microscopy, the student takes up photomicroscopy, for which he has been prepared by a thorough course in the common processes of photography. The types and constructions of photomicrographic apparatus, adjustments, and exposures are taught by actual work in the photomicrographic laboratory. The student studies the use of such auxiliaries as color filters, polarized light, dark-ground illumination, color photography, and works at both high and low magnifications. At the end of the course the student is given a typical industrial or research problem on which he works independently and upon which he must prepare a complete report, illustrated by appropriate photomicrographs. [Course IV.]

Quantitative Analysis—C–48. Preparation: C–30. This course consists of lectures, recitations and quizzes on the fundamental principles of analytical chemistry. [Course IV.]

Report Writing—C–49. The purpose of this course is, in general, to enable the student to write a technical report clearly and forcibly, and specifically to assist the student in preparing a well-written thesis.

An analysis of a complete formal report is first made. This is followed by a bibliography and instructions in the use of reference books and technical magazines. The methods of obtaining data, control of variables, and the use of graphs is taught by actual practice on laboratory results. The desirability of good mechanical form is emphasized, and a short review of punctuation is included.

Throughout the course the student is required to submit many reports, formal and informal, technical and non-technical, oral and written.

Frequent reports on the progress of the student's thesis are required so that he obtains practice in the correct presentation of the original data which he has obtained and the course is completed by the preparation of a formal thesis. [Course IV.]

Thesis—C–50. Before graduation the student must present a thesis which shall consist of a report of some original investigation or research that he has conducted while at the school.

A relatively large number of hours are specially set aside for this work, and students are encouraged to select some object for their investigation which shall be of practical as well as theoretical interest. [Course IV.]

TEXTILE DESIGN AND WEAVING DEPARTMENT—D

Textile Design and Cloth Analysis—D–10. During the first year instruction is given in the subject of classification of fabrics, use of point or design paper, plain fabrics, intersection, twills and their derivation, sateen, basket and rib weaves, checks and stripes, fancy weaves, including figured and colored effects; producing chain and draw from design, and *vice versa;* extending and extracting weaves.

This subject takes up in a systematic manner the analysis of samples illustrating the various cloth constructions for the purpose of determining the design of the weave and the amount and kind of yarns used, and forms the basis of calculation in the cost of reproducing any style of goods. The various topics discussed are reeds and setts; relation and determination of counts of cotton, woolen, worsted, silk and yarns made from the great variety of vegetable fibers; grading of yarns, folded, ply, novelty and fancy yarns; application of the metric system to yarn calculation; problems involving take-up, average counts, determination of counts of yarn, and weight of yarn required to produce a given fabric. [First term, all courses.] [Second term, Courses I, II, III, VI.]

Textile Design and Cloth Analysis—D–20. For Cotton Goods—Preparation: D–10. During the second year consideration is given to fancy and reverse twills, diaper work, damasks, skip weaves, sateen fabrics with plain ground, backed

fabrics, and multiple ply fabrics. Students are required to make original designs and put the same into the loom. Special attention is given to the consideration of color effect.

During the first term free-hand drawing is taught by means of plates, and practice in coloring is given in conjunction with this work.

Practice in lettering, spacing and general arrangement of designs and sketches is given. The engineering alphabet is used in all work.

During the second term instruction is given in drawing, sketching, coloring and designing, with reference to their application in textiles. Good examples of applied design in textiles, as well as in other branches, are used as a basis for modified designs selected and composed by the student. This stimulates originality as well as teaches the student to appreciate good designs and color.

The analysis of these fabrics forms a part of the course in design. This also includes the necessary calculations required to reproduce the fabric or to construct fabrics of similar character. [Courses I, III, VI.]

Textile Design and Cloth Analysis—D–21. For Woolen and Worsted Goods—Preparation: D–10. During the second year the instruction given includes warp and filling backed cloth, figured effects produced by extra warp and filling, double cloths, multiple ply fabrics, cotton warps, blankets, bathrobes, crepes, filling reversible, Bedford cords, imitation furs, crepons, matelasse and imitations, double plain, ingrains, velvets, corduroys, overcoatings, trouserings.

The analysis of these fabrics, together with the consideration of the shrinkages and dead loss in all fabrics, theory of diameter of yarns, and costs of blends and mixes is a part of this course. [Courses II, III, VI.]

Textile Design and Cloth Construction—D–30. Preparation: D–20 or D–21. The advanced work takes up the more complicated weaves adapted to harness work, and leads into leno and Jacquard designs. The following is a brief list of the subject heads, which will give some idea of the course: double plain cloths, ingrains, tricots, chinchilla, tapestry, blankets, upholsteries, spot weaves, pile or plush, crepon, matelasse and its imitations, piqué, Marseilles, quilting, and miscellaneous designs for Jacquard, leno, fustian, tissue fabrics and lappets.

Original designs and sketches for particular grades of goods and the study of color effects form an important part of the third-year course. It should be understood that work in decorative art is carried on in conjunction with textile construction and weaving, particularly on the Jacquard loom. Designs of merit are carefully developed in detail and woven into cloth.

The work in cloth construction includes the application of the different weaves and their combinations in the productions of fancy designs, both modified and original; the calculation involved in the reproduction of standard fabrics changed to meet varying conditions of weight, stock, counts of yarn and value; and the discussion of the breaking strength of fabrics and relationship of the construction of the fabric to breaking strength.

Instruction in this subject, which is given by classroom work, is intended to bring together the principles considered under the subject of design, cloth construction, weaving and yarn making of previous years, and to show the bearing each has in the successful construction of a fabric. [Courses III, VI.]

Decorative Art for Special Students. This course is planned to give a student a working knowledge and appreciation of design. The first and second years are devoted to a general study of design, color, perspective, lettering and rendering. Drawings are made in the historic styles for all materials,—wood, gold, silver, copper, brass, leather, fabrics, wall papers and glass.

In the third year students should specialize and devote their attention to the material in which they expect to work.

Power Weaving—D–22. Preparation: D–10. In connection with the work in Textile Design and Cloth Analysis practical work is carried on upon the power looms. This includes the preparation of warps, beaming, dressing, sizing, drawing-in and making of chains, the cutting and lacing of cards, spooling and quilling and the machinery for the same. A study is made of warpers and sizing machines, both for cotton and woolen. Lectures are given to correspond with the progress of the student in the Power Weaving Laboratory covering the following subjects:

loom adjustments, chain building, shuttle changing looms, dobby looms, single and double acting dobbies, handkerchief motions, leno weaving, center selvedge motion, filling changing looms, oscillating reeds, lappet motions, various shaker motions, towel and other pile cloth weaving, Jacquard looms, single and double lift leno Jacquards, Jacquards of special design, tying up Jacquard harness. [Courses I, II, III, VI.]

Power Weaving—D-31. Preparation: D-20, D-21, or D-22. Instruction is given in weaving on fancy woolen and worsted looms, single and double acting dobbies, leno weaving, various shaker motions, lapper loom weaving, double and single lift Jacquard looms, tying up Jacquard harness, leno Jacquard, harness and box chain building; warp preparation for woolen and worsted and cotton; formulas for making up different kinds of sizing. Lectures are given to correspond with the same. [Courses I, II, III, VI.]

LANGUAGE AND HISTORY DEPARTMENT—E

English—E-10. Preparation: Admission Requirements. A technically trained man should be able to express himself clearly, forcibly and fluently, as inability to do so will be a serious handicap to him in after life. The object of the English course is to develop the student's power of expression by a thorough study of the principles of advanced rhetoric and composition, and by constant writing of themes illustrative of the four forms of discourse, viz., description, narration, exposition and argumentation. In addition to the study of rhetoric and composition and the writing of themes, several classics such as are not read in the preparatory schools are studied and discussed. [All courses.]

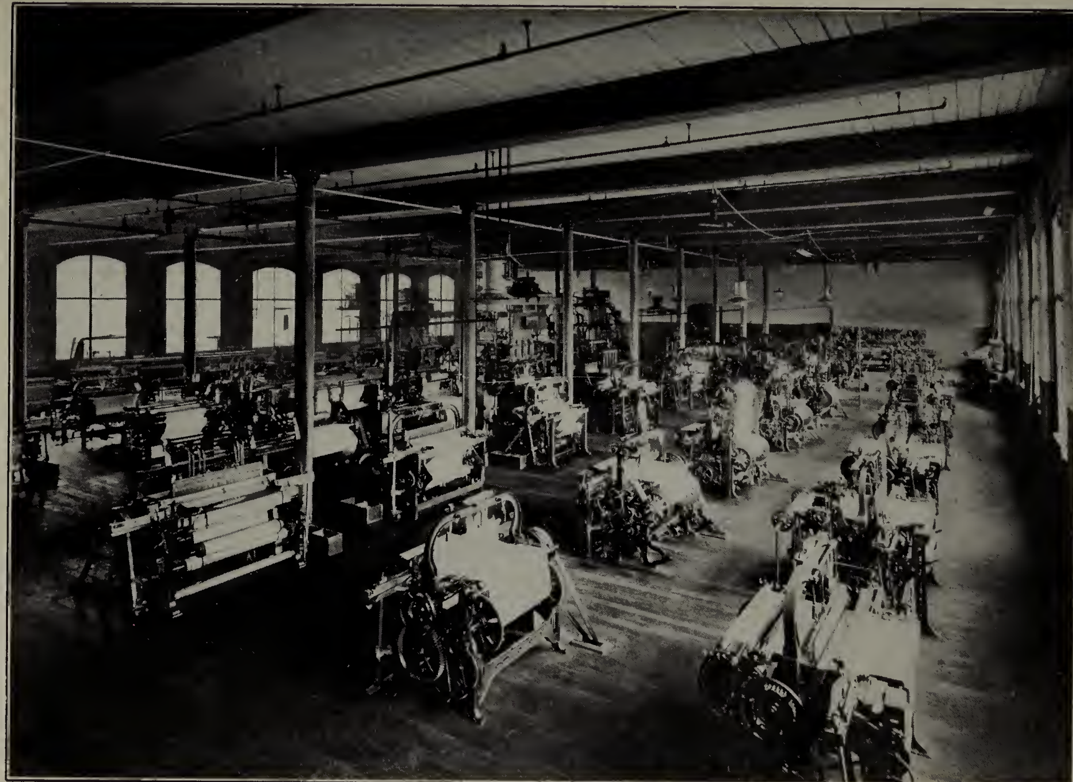
Elementary German—E-11. Preparation: Admission Requirements. This course is intended for first-year students who do not offer German as an entrance requirement and who desire to take the course in Chemistry and Textile Coloring. It may be selected by students taking the Textile Engineering course who have not fully met the entrance requirements in language. The work is elementary in character, and much time is devoted to the study of the rudiments of German grammar with practice in composition. During the latter part of the year considerable attention is given to the reading of ordinary German prose, which serves as an additional preparation to the student for the later reading of works along scientific and industrial lines. [Course IV.]

Advanced German—E-21. Preparation: E-11. For students taking the course in Chemistry and Textile Coloring the elementary course of the first year is continued throughout the second year. The work consists of the study of some of the more advanced principles of grammar, and especially of the reading of scientific German, dealing with a variety of subjects, and the translation of commercial German. [Course IV.]

Economics—E-30. Preparation: E-10. This course, meeting three times a week, is conducted by means of lectures, discussions, and recitations, supplemented by textbook reading and study of charts analyzing various phases of industrial problems. The character of the course is descriptive and practical rather than theoretical, and the aim is to acquaint the student with the accepted principles of economics and some of their applications to industrial conditions.

The course will also deal briefly with economic history, showing how the present economic system has evolved from past systems and pointing out how the experience of the past can aid in the solution of present problems.

Besides the historical material, other topics discussed are the nature and scope of economics; the evolution of economic society; the three factors of production, land, labor and capital; the four elements in distribution, rent, wages, interest and profits; business organization; value and price; monopoly; money, credit and banking; international trade; protection and free trade; transportation; insurance; economic activities of municipalities; and public finance. In short, it is an outline course dealing with the fundamental principles that underlie a wide range of activities. [Courses IV, VI.]



Weave Room

COTTON DEPARTMENT—F

Cotton Technology of Fibers—F-10. This course, given during the second term of the first year, takes up in considerable detail the culture and production of commercial cottons. The various commercial varieties and their characteristics are considered in detail. The classifying of cottons by grade and staple are thoroughly considered and during the last part of the course considerable time is given to the study of the intricate marketing system by means of which raw cotton is distributed. This course is given to those students who will continue the study of cotton yarn manufacture. [Courses I, III and VI.]

Cotton Technology of Fibers—F-10a. This general course of lectures, given during the second term of the first year, covers in a broad way the manufacture of cotton into yarns. The instruction covers the classification, grading and stapling of cotton, a study of the mechanical operations in yarn manufacture, a consideration of the product and waste of each of the operations, and the uses for which various yarns are suited. [Courses II, IV.]

Cotton Carding—F-20. Preparation: B-10, B-12, B-14, F-10. Instruction is given by means of lecture and laboratory work. The outline of the course is as follows:—

Opening and Picking.—Instruction in the preliminary operation of opening and picking covers the mechanical construction of the machines, their parts and adjustments, as fully as the manufacturing results accomplished by the machines. This includes such construction details as evener, lap measuring and safety stop motion, grids, cleaning trunks, beaters, etc.; also operation details which involve the adjustment of waste, drafts and character of laps.

Carding.—The process of carding is considered one of the most important, and proper time is devoted to the construction and operation of cards, that the student may be familiar with the various parts of the card and the function and design of each. The construction and application of card clothing, as well as the methods of grinding, form a part of the work.

Combing.—This process is explained by lecture work and by operation and assembling of the various types of combs in service in the laboratory. The object of combing is fully considered, and the different means employed on the many types of combers on the market is studied. This includes such types as the Heilman, New Whitin and Nasmith combers.

Drawing.—Under this head is taken up the theory of doublings and their effect upon the quality of roving and yarn. Like previous and subsequent processes the machine construction forms an important part of the work. Proper stress is paid to such subjects as stop motions, drawing rolls and their covering, cleaners and evener motions.

Roving Processes.—Under this head are studied the various machines known as the slubber, intermediate, fine and jack fly frames. The relative motion of the various parts of these machines is so complex that a good opportunity is here presented to fix in the student's mind the application of certain mechanical principles that are used in other departments and upon other machines in the manufacture of textile material. With each process of yarn manufacture are explained the systems of sizing and numbering, and under this head are taken up both the metric and English systems. [Course I.]

Cotton Carding—F-20a. Preparation: B-10, B-12, B-14, F-10. This course is similar to Course F-20, except that there is much less time devoted to lecture and laboratory work. [Courses III, VI.]

Cotton Spinning—F-30. Preparation: F-20. Ring Spinning and Twisting.—The consideration of spinning yarn by the ring frame method involves a knowledge of the uses to which the yarn is to be put, subsequent methods of handling that proper roving may be selected, suitable amounts of draft and twist provided, correct size of rings and travelers selected, building motions suitably adjusted, etc. The operation of twisting yarns is so closely related to spinning by the ring method that it is studied at the same time. This opens an almost limitless field of novelty yarn manufacture, and offers a very good opportunity to derive new types of yarn or new mechanism to produce the effects. Yarn defects are studied with reference to the cause and remedy.

Mule Spinning.—This method of spinning is very different from that of the ring frame, and the mechanical details are more complicated. The student is furnished with new means of producing yarns and can compare the relative advantage of each method. A thorough understanding of mule spinning is perhaps more a study of mechanical motions and their functions. This results almost invariably in assisting the student to understand previous processes and machines better because of his work on the mule. It is the object to make clear to the student's mind the principles underlying the construction and operation of the parts that control the drawing, twisting, backing off, winding, together with such special motions and devices as are used upon the modern mule.

Spooling.—This subject involves a study of the various types of spoolers, spooler speeds, tensions and production.

Winding.—The different makes of winders, the packages they make, the peculiarities, special features and production of each are discussed in this work.

Reeling.—Under this topic is included the construction of the machine, the types of winding possible, the quantity of yarn in a skein, and the packing of skeins into bundles. Course I.]

Cotton Spinning—F–30a. Preparation: F–20a. This course is similar to Course F–30 except that there is much less time devoted to laboratory work. [Courses III, VI.]

Knitting—F–31. Preparation: B–12, D–10. This course, commencing with a study of hosiery yarns and their preparation for knitting, includes a study of the various stitches and their application in commercial fabrics; a study of the different knitting machines, including circular and flat, spring and latch needle machines, used in the manufacture of stockings, sweaters and underwear; and a study of looping and sewing machines. Part of the work consists of the assembling and adjusting of different types of knitting machines.

In addition, considerable time is spent in the analysis of knitted fabrics. [Courses I, II.]

Knitting—F–31a. Preparation: B–12, D–10. This course embraces the same lectures as Course F–31 but does not include any laboratory work. [Course VI.]

Cotton Organization—F–32. Preparation: F–20 or F–20a. This course correlates all the work in the Department of Cotton Yarns. The student is instructed how cotton yarn mill organizations are made, by the study of actual mill organizations, showing the drafts, doublings and sizes in use. This is followed by the calculation of machinery necessary to equip a given plant and the arrangement of this machinery in the mill building. Some time is given to the study of special equipment not specifically covered in other classes. [Courses I, VI.]

Cotton Research Laboratory.—F–33. Preparation: F–20. This is a short course in which the student studies the method of approach to various cotton mill problems. It acquaints him with the usual apparatus for a study of the physical defects in yarns and fabrics, using a variety of the more common ones as illustrations. [Courses I, VI C. O.]

Thesis—F–34. Each student is required to present a thesis which is a report of some original work. This is sometimes the construction of some yarn or fabric to meet certain requirements. At other times the work is a study of some technical problem regarding the effect of certain changes in manufacturing conditions. [Course I.]

WOOL DEPARTMENT—G

Technology of Fibers—G–10. The principles of converting loose fibrous materials into continuous twisted strands called yarn are discussed, and the nature and uses of spindle-drawn and roller-drawn yarns explained. Particular attention is given to the nature and processing of wool, allied fibers and reworked fibers. The source of supply, original and clean cost, and the effect of tariff and exchange on fibers and processed materials from foreign countries, are illustrated by examples. [All courses.]

Top Manufacture—G–20. Preparation: B–10, B–12, B–13. Raw Materials.—A study of raw materials which enter into the manufacture of woolen

or worsted yarns, or are made into yarns by processes similar to those employed in the manufacture of woolen and worsted yarns, would include silk, mohair, alpaca, vicuna, cashmere, camel's hair, cotton, flax, hemp, jute and ramie. In connection with these are considered shoddy, noils, mungo and extracts.

Wool Sorting.—Familiarity with the various grades and kinds of wool is obtained by lecture and by actual sorting of fleece wool under the direction of an experienced wool sorter. The various characteristics and properties are explained, as are also trade names, such as picklock, XXX, XX, ½-blood, ⅜-blood, ¼-blood, delaine, braid, etc. Some skill is acquired in the estimation of shrinkage and in judging the spinning qualities.

Wool Scouring.—The object of scouring and the methods employed are explained, and this involves the consideration of the soaps and chemicals used in washing; also the waste products and their utilization. Actual work is done in scouring a commercial quantity of wool by machines that are made similar in operation to regular commercial machines. A study is made of the effect of the hardness of water upon soap; also tests are made to show this effect. At the same time the use of dryers, their operation and regulation, is taken up, and the methods of carbonizing wool, noils, burr waste, rags, etc., are studied and practised.

Burr Picking, Mixing and Oiling.—In these processes preliminary to carding, the students have an opportunity of mixing various colors of wools to produce different effects and the influence of varying percentages of a given color in a mixture can be seen. Each student is required to make at least twenty sample mixes combining different colors and grades of stock, and to felt and mount the same. Under the subject of oils and emulsions are taken up the characteristics of various oils and the means employed to test these. The use of mixing and burr pickers is made clear.

Carding.—The different systems of carding wool, depending upon whether it is to be made into woolen or worsted yarn, are fully explained, as is also the construction, setting and operation of the cards. A part of the work is the reclothing and grinding of the cylinders, strippers, workers, etc. The carding of suitable and commercial quantities of wool, and the further manufacture of it into yarn, serves to fix the principles of carding in the mind of the student, as well as to give him some skill in handling machinery. At the completion of this part of the work he is required to prepare and hand in a full description of the process of carding, including working drawings, sketches, etc., to fully explain the machines and the methods.

Woolen Mule.—The student studies thoroughly the operation of the mule as a whole, and acquaints himself with the various principal mechanisms, as, for example, the backing off and winding motions, the quadrant, builder-rail, faller regulation, etc.

Top Making and Combing.—This branch takes up, besides the carding of the wool on a worsted card, the preparing processes, back-washing and Vigoureaux printing, also gilling of the stock before and after combing. The construction of the gill boxes and combs is studied by lectures and by dismantling and assembling these machines in the laboratories. Later, quantities of stock are made into top and then into yarn.

The Noble comb is studied, and the various calculations to determine draft, noiling, tear, productions, etc., are made. [Courses II, III, VI.]

Yarn Manufacture—G–30. Preparation: G–20. Intersecting Gill Boxes and French Comb.—The equipment of the laboratory offers opportunity for the production of dry-combed top and its comparison with oil-combed top produced on the Noble comb. The structures and uses of intersecting gill boxes and the study of combing and drawing blends is taken up at this point.

Drawing and Spinning.—The laboratory equipment consisting of the Bradford (English) system of drawing, of both open and cone types, as well as the various processes of French drawing, followed by both worsted mule and ring spinning frame, make possible a thorough study of the manufacture of worsted yarn by all of the existing methods.

The same method of study of mechanisms, calculations, and operations of the various machines is followed as in the case of previous methods of instruction. The

student by pursuing this course can compare the different methods of yarn manufacture and note the results of each.

ORGANIZATION.—At the end of the course the layout of a properly balanced yarn mill is studied, and at the same time the cost of machinery, depreciation, labor costs and machinery arrangements.

THESIS.—Before graduation the student must present visible evidence of his knowledge of woolen and worsted manufacture by the production of twenty yards of fabric from his own design (or reproduction or modification of some existing fabric) beginning with the raw material.

A formal typewritten description, including all calculations and observations, together with samples from each machine, must be presented to the head of the department before the final examination. [Courses II, III, VI.]

Textile Testing—G-31. Preparation: B-22, F-30 or G-30, D-22. The object of this course is to familiarize the student with present-day methods of determining the physical properties of textile fibers, yarns and fabrics. The application of physical laws and methods of measurements, as studied in the course of Physics, is used in the study of physical characteristics of textile material. The work is given to students in advanced courses, and consists of lecture and laboratory work. Reports are prepared from each experiment, giving the object of the experiment, method of procedure, observation and conclusions, in order that the student may acquire practice and understand the interpretation of data. A special testing laboratory is provided, and a considerable number of the best standard fiber, yarn and fabric testing instruments of foreign and American make have been installed and are used for instruction in the testing of textile materials. The laboratory is equipped with means for making and keeping the humidity constant, so that tests can be made under uniform or standard conditions of humidity and temperature. [All courses.]

FINISHING DEPARTMENT—H

Woolen and Worsted Finishing—H-30. Preparation: B-12, C-10, D-10, D-22. The outline of this course, which is given by means of lecture and laboratory work, is as follows:—

BURLING AND MENDING.—Under this head is taken up for consideration the examination of flannel as it comes from the loom; the construction, use and location of the perch; the methods used in marking defects, measuring, weighing and numbering of cloths; also the methods of inspection for fancies, single cloths and double cloths. The object of burling, mending and the types of tables employed, the method of removing knots, runners, etc., the object of back shearing and the use of burling irons, the replacing of missing threads and the importance of sewing as a part of the finishing process, are all considered in detail. The removal of oil and tar spots as well as stains of various kinds is studied.

FULLING.—This branch covers a study of the conditions of the flannel as it comes from the loom, and the influence of oil, etc., upon the procedure. Considerable time is devoted to the various methods of producing a felt, the early types of stocks, hammer falling and crank stocks, and their modifications and development into the present type of rotary fulling mills of both the single and double variety. The details of construction in all machines are carefully taken up and include the design and composition of the main rolls, methods of covering, regulation and means of adjusting the pressure of traps and rolls, consideration of the shoes, the use and regulation of the various types of stop motion, the different types of stretchers, guide rolls and throat plates.

The theory of felt is taken up and the influence of pressure, moisture, heat, alkali and acid is considered, as well as the hydroscopic and felting properties of different wool fibers. The preparation of the flannel for the mill and the usual methods of determining shrinkages, as well as the various methods of soaping, are given careful attention. The preparation of various fulling soaps and the value of each for the production of various degrees of felt as well as the determination of the proper amount of alkali for various goods, are carefully studied and demonstrated. The manipulation of the various kinds of goods in the mill, viz., all wool, shoddies and mixed goods, is studied in classroom and by operation in the mill.

The change in weight and strength for each operation is carefully considered, as is also the value of the flocks made in each. A study of the various methods of flocking, such as dry and wet, is considered in both class and machine rooms. In each operation the defects likely to materialize are studied, as well as the cause thereof, and various methods of modifying or lessening them.

Washing and Speck Dyeing.—This branch considers the scouring, rinsing and washing of goods both before and after the fulling process; the various types of washers; and the details of construction, such as suds box, rolls, etc. The theory of scouring, uses of Fuller's earth, salt solutions and scours on the different kinds of goods are made clear by practical work in the machine room, where the effects due to improper scouring, such as stains, cloudy effects, wrinkles and unclean goods, are demonstrated. The discussion of the necessity of speck dyeing follows naturally from the study of these matters, and includes methods of preparation, materials used, application and tests required.

Carbonizing.—This is an important branch of finishing, and includes a study of the various carbonizing agents, methods of application, strength of solutions, and neutralizing, as well as the machines used. Stains and imperfections resulting from carbonizing are also considered. The drying and tentering machines and extractors employed are taken up at this point.

Gigging, Napping, Steaming, Singeing and Crabbing.—The construction in detail of the various types of gigs, nappers, steamers, wet gigs, rolling, stretching, crabbing, and singeing machines is discussed, and their actions upon the cloth and the results obtained are explained.

Various methods of obtaining luster and the production of permanent finish are considered in connection with steaming and sponging.

Brushing, Shearing and Pressing.—This includes, as do the other branches, a careful treatment of the machine employed, the preparation of the cloth for each process, the action of each machine in producing its part of the resultant effect. In manipulation of the shear consideration is given to its setting, grinding and adjustment. With the brushing machine the effect of steaming and moisture upon the luster and feel of the goods is shown. A study of the action of the presses, both plate and rotary, involves consideration of pressure, steaming, etc. Special processes to obtain particular effects are taken up, and the part played by each machine is explained. The details involved in handling cloth on a commercial scale, as, for example, measuring, weighing, ticketing, numbering and rolling, are also explained. The necessary calculation and the methods of finishing all grades of goods are considered from time to time during the year. [Courses II, III, IV, VI]

Cotton Finishing—H-31. Preparation: B-12, C-10, D-10, D-22. The outline of the course in the finishing of cotton fabrics is as follows:—

Cloth Room.—Instruction of the various goods and the object thereof; construction of the various types of inspecting and trimming machines.

Shearing.—The object. A consideration of the various types of shears for treating one or both sides at the same time; also the use of the usual cleaning devices, such as emery, sand and card rolls, beaters and brushes; grinding and the adjustment of the various parts.

The use of brushing and cleaning machines, rolling devices and calender attachments for gray goods.

Singeing.—Developing and object of singeing; the construction of singers of all types and for various purposes; the use of cooling tanks, steaming devices, rolling and brushing attachments.

Regulation of the flame for various goods, and adjustment of the parts; gas and air pressure, water-cooled rolls; the effect of moisture on the cost of singeing and use of dry cans in connection with singeing; electric singeing.

Washing.—Open width and string washers, their construction and operation: soaps, temperature, squeeze rolls; washing of various goods and the object thereof; stains.

Napping.—The object of napping and the usual method of treating goods; various types of nappers, single and double acting; felting nappers; construction, grinding and adjustments of various types.

Water Mangles.—Their objects and the construction of various types; various rolls, iron, husk, etc.; scutchers, their object and constructions.

Starch Mangles.—The object and construction of all types of starch mangles for pure starch and filled goods; various types of rolls, brass, rubber, wood; action of doctor blades, etc.; regulation and object of pressure.

Methods of starching and finishing all standard goods, also a consideration of the various substances used, such as starch, softener and fillers; the preparation of starch and various methods of application.

Dryers and Stretchers.—Both horizontal and vertical types of drying cans, tenter frames, clips, etc.; the swing motion and the finishes thus produced; object and construction of spraying machines, belt stretchers, short tenters, button breakers, etc.

Calenders.—The object and construction of all types, including the regulation of pressure and nips for the production of various finishes; various types of rolls and their uses,—steel, husk, cotton, paper, etc., the use of hot and cold rolls; chasing, friction, embossing and Schreiner calenders, and the various finishes produced by each; production of watered effects; beetling machines and hydraulic mangles.

Making-up room,—yarding, inspecting; different types of folds; pressing, papering, marking. [Courses I, III, VI.]

PHYSICAL EDUCATION

All members of the freshman class are required to take a course in physical training conducted in the gymnasium under the direction of an instructor in physical education. Two periods per week for the entire first year are devoted to this work. At the beginning of the year a full record is made of the physical examinations carried on by the instructor and a reputable physician that proper and beneficial exercise may be prescribed.

The object is to give general instruction in the care and strengthening of the body, and to so guide the students that they may continue to give proper thought to their physical training that their mental development may have its greatest effect.

Proper gymnasium clothing is required and all students must take a shower bath following each exercise.

EQUIPMENT

The equipment of machinery, inventoried at $330,850.00, is most varied for textile educational purposes, and is being constantly augmented. The builders of the various machines installed keep in close touch with the Institute, adding to the machines such improvements as are made from time to time, and each year some new machine will be added by a manufacturer who finds it to his advantage to be represented here. This operates to the mutual advantage of student and manufacturer.

Cotton Yarn Department.—The opening and picking section of this department contains a 50-saw Pratt gin used for experimental purposes. For classing work, there is a specially equipped section with north light, where Universal Standard Grades and Government Staple Standards are available.

The picking equipment consists of two Kitson pickers, one 40-inch two beater breaker lapper with an automatic feeder and one 40-inch finisher lapper with a Perham and Davis evener. There is an extra Kirschner patent carding beater to be used in this finisher picker.

The card section has three standard revolving flat top cards, one each from Saco-Lowell, Whitin, and Howard and Bullough shops. One of these is equipped with a Chapman electric neutralizer to prevent trouble from static electricity.

The combing section consists of a sliver lapper, one four-head ribbon lapper, one six-head ribbon lapper, one two-head comb, one six-head comb and one eight-head comb, all from the Whitin Machine Works. There is also one two-head Nasmith comb from John Hetherington and Sons of England.

The drawing frames are all of the single head type. There are two four-delivery drawing frames and one railway head from the Saco-Lowell Shops. One frame is equipped with both common and metallic drawing rolls, electric stop motions and Ermine top roll clearers. The other frame and the railway head both are equipped with metallic rolls and mechanical stop motions. Another frame of two deliveries is from the Howard and Bullough shops. It has electric stop motions and metallic drawing rolls.

The roving section has a complete equipment, slubber, intermediate, fine and jack frame from the Saco-Lowell Shops. In addition, there is an intermediate frame made by the Woonsocket Machine and Press Company, and a fine frame from Howard and Bullough. The last named serves to illustrate the common English construction and how it differs from the American construction as illustrated in the other roving machines.

The spinning equipment is quite varied both with respect to builders and with respect to types and sizes. The Saco-Lowell Shops have supplied five different frames varying from 36 to 216 spindles. They are suitable to spin counts from 3s to 80s. One is equipped with the LeBlan Roth long draft system, while another has a special five roll long draft system built in the Institute. A sixth Saco-Lowell frame was supplied by the Acme Machine Company equipped with Chapman ball bearing spindles. Four of these frames are equipped with individual motor drives,—one chain drive, one Texrope drive, one gear drive and one Washburn clutch drive. The Whitin Machine Works is represented by three frames on which counts from 3s to over 100s can be spun. One of these frames has an auxiliary equipment of SKF roller bearing spindles. The Howard and Bullough shops have one spinning frame suitable for counts from average to fine. This is equipped with an English type of builder which distinguishes it from the other frames. One Fales and Jenks frame is present, equipped on one side with the Casa Blanca long draft system. This machine is equipped with an individual alternating current motor with a chain drive. One spinning mule has been retained to illustrate this peculiar type of spinning. It is from Asa Lees Company of England and is suitable for counts above 30.

There is one short spooler from the Saco-Lowell Shops. There are two winders from the Foster Machine Company, one for single ends either on cones or tubes, the other for one, two, or three ends parallel wound, especially for preparation for twisting. There is also a one gang Universal No. 50 winder suitable for winding ordinary tubes or Franklin Process packages.

The twisters are suitable for all counts. There is one each from the Saco-Lowell, the Howard and Bullough, and the Fales and Jenks Shops. These are all equipped for either wet or dry twisting of average and fine counts. There are two twisters from the Draper Corporation. These are equipped for wet or dry twisting for coarse counts or heavy plies.

The department has a complete coiler waste system as made by the Saco-Lowell Shops, consisting of a 40-inch single coiler side delivery breaker card; a 40-end derby doubler; a 40-inch four coiler finisher card; a combination slubber-intermediate and a waste spinning frame. This equipment is suitable to spin coarse numbers from cotton wastes to be used in such materials as coarse sheeting, osnaburgs, twine and mop yarns.

To prepare mill wastes for re-use there is one single cylinder roving waste opener and one thread extractor, both from the Saco-Lowell Shops.

With the exception of the opening-picking room the humidity in this department is controlled automatically by a system installed by the American Moistening Company. Seven high duty heads supply the necessary moisture and air circulation. An adjustable automatic control regulates the humidity to the desired per cent.

The experimental laboratory is equipped with a power driven skein tester for determining yarn strength and a Moscrop single thread tester for single end strength. There are twist counters for determining the amount of twist and the twist contraction. For fine work and for fiber study, there is an analytical balance and a Spencer microscope equipped with three objectives, three oculars, ocular micrometer, mechanical stage and Abbé condenser. In addition, there is a gas conditioning oven to use in determining moisture content and regain. A number

of scales and balances, together with yarn reels, roving reels and measuring boards make up the equipment for routine mill sizing tests.

Knitting Section.—The winders for this section include a six-spindle Universal winder for cones and tubes and a Payne bobbin winder.

The machines in the following group are equipped with special attachments for producing high splicing, double soling and striped work. The hosiery machines include two Acme full automatic, one arranged for 160 needles and the other for 200 needles; also a Mayo Model C full automatic arranged for 220 needles. Scott & Williams have placed in this section four of their machines, Models B-5, K, HH and RI. There are three Banner machines, all full automatic, two of which are arranged for 220 needles each and one arranged for 160 needles. There is one Brinton full automatic arranged for 176 needles and one Branson hand machine arranged for 80 needles. For hosiery legs and tops there are five ribbers, made by the Wildman Company, with cylinders varying from 3½–5¼ and arranged for needles varying in number from 160–240; two Brinton ribbers, one arranged for 176 needles and the other 200 needles; one Brinton tie machine, 1¾-inch cylinder 100 needles and 49 needles; one Universal Ribber 3½-inch diameter, 160 needles.

The underwear machinery consists of one Crane spring needle machine, one Scott & Williams ribber, and one Wildman ribber.

Under the group of flat machines there are three Lamb machines, one arranged for knitting gloves and one arranged for knitting sweaters. In addition to these there is also a Grosser sweater machine, a Jacquard machine, and a link and link machine; a Dubied scarf machine; and a Raschel warp knitter.

For finishing work this section includes a Grosser 2-thread looper, one Hepworth looper, two Beattie loopers; five Union special sewing machines for overseaming, double stitch covering, seaming and welting and vest finishing; six Merrow sewing machines, including two shell stitch machines and three overseaming and crocheting machines; three Singer machines; three Wilcox & Gibbs sewing machines, including a flat lock machine.

The Philadelphia Metal Drying Form Company has installed a table of six forms including men's, women's and children's.

For instruction in the manufacture of braids the New England Butt Company has installed one 24-line Hercules braider, one 12-line braider, one tubular braider, and one soutache braider.

Wool Yarns Department.—For instruction in wool sorting and grading the room is provided and equipped with benches, baskets, etc., as well as standard samples of all grades of wool which may be used for comparison and examination.

The scouring and carbonizing equipment installed by C. G. Sargent's Sons Corporation consists of one cone duster for grease wool; four scouring bowls arranged in tandem with necessary feeds and modern carrying properties; one single apron dryer, with automatic feeder; one carbonizing screw acid tank and duster, with crush rolls. In this same department the North Chelmsford Machine Company has supplied a rinse box; Schaum & Uhlinger, one hydro-extractor; C. S. Dodge, one shoddy picker and one bagging stand.

Woolen.—In the woolen section there has been installed by the Atlas Manufacturing Company a Parkhurst burr picker. The Davis & Furber Machine Company has installed a mixing picker equipped with improved mixing picker feed and Spencer oiler, both made by George S. Harwood & Son, Boston, Mass. There are three sets of woolen cards furnished by Davis & Furber Machine Company which are equipped with Bramwell feed furnished by George S. Harwood & Son. One of the sets has the first and second breaker cards coupled. All have apron condensers on the finishers. There is a sample mixing card furnished by the Torrance Manufacturing Company which offers an opportunity for carrying on experiments and mixing various kinds and colors of wool. There are two spinning mules, 120 spindles each, one furnished by the Davis & Furber Machine Company of North Andover and equipped with bobbin holders supplied by the American Bobbin Holder Company, West Medway, Mass., and the other furnished by Johnson & Bassett, Worcester, Mass. In addition to these two mules each company has supplied for the purpose of instruction a spinning mule head mounted on movable platform to facilitate class instruction. Besides these mules the Davis

Wool Combing

& Furber Machine Company has supplied a fancy yarn twister; 20 spindles; the Lindsay Hyde Company modern skein winder. For card grinding the B. S. Roy & Son Company of Worcester, Mass., has supplied one grinding frame and two traverse grinders; T. C. Entwistle Company, Lowell, Mass., one traverse grinder; W. H. Brown, Worcester, Mass., one complete set of carder's tools.

Worsted.—In the worsted section the Davis & Furber Machine Company has furnished one double-cylinder worsted card (4 licker-in) with Bramwell feed. On this card as well as one in the woolen section the Chapman Electric Neutralizer Company has supplied one of its patented electric neutralizers. This section also includes a double bowl, 5-cylinder back-washer, with gill box, Taylor-Wordsworth & Co., Leeds, Eng., equipped with blueing motion, oiling motion, and Layland patent pressure motion; a weigh gill box and creel and one doubling balling head gill box (with double screws) made by the Saco-Lowell Shops of Lowell, Mass.; a worsted comb with baller punch made by Crompton & Knowles, Worcester, Mass.; two finishing gill boxes, one known as a can gill box and the other a balling head gill box, both made by Hall & Stell, Keighley, Eng.

For the manufacture of yarns under the Bradford System of Drawing, Spinning and Twisting, the following machinery as made by Prince Smith & Son, Keighley, Eng., make up the equipment: one revolving creel for 12 balls, one 2-spindle drawing box, one 4-spindle first finisher, one 12-spindle dandy reducer, one 12-spindle cap spinner, one double head can gill box, one 2-spindle gill box, one 2-spindle flyer spinner, one 12-spindle ring spinner, one 12-spindle 2-fold cap twister, one 12-spindle 6-fold ring twister. In addition to this the Saco-Lowell Shops, Lowell, Mass., have installed the following machinery to carry on similar work: one 2-spindle drawing box, one 6-spindle second finisher, one 24-spindle dandy rover, one 6-spindle cone reducer, one 8-spindle cone rover, one 48-spindle cap spinner, 5-foot end, one 48-spindle cap spinner, 4-foot end, one 48-spindle Boy ring twister. For conditioning yarn C. G. Sargent's Sons Corporation has supplied one of its conditioning machines. The Universal Winding Company has installed one of its 6-gang winders, equipped for cones or straight tubes.

The humidity in the laboratory of the woolen yarns and of the English system of worsted yarns is maintained by the American Moistening Company's system through its automatic control. In this laboratory are installed six humidifiers and four Comin's High Duty heads, which are supplied from an electric-driven triplex power pump located in the power house. This same pumping equipment supplies the American Moistening Company's humidifiers operating in the Cotton Yarn Department.

For the manufacture of worsted yarns under the French System of Drawing and Spinning the machinery has been made by the Société Alsacienne de Constructions Mechaniques, Mulhouse, France, and the equipment consists of the following: Model P. L. B. comb with creel for 24 doublings, intersecting gill box (2 heads), gill box (2 heads), first drawing (2 heads), second drawing (2 heads), third drawing (2 heads), reducer (4 porcupines), slubber (8 porcupines), first intermediate (8 porcupines), second intermediate (8 porcupines), rover (8 porcupines), finisher (16 porcupines), self-acting worsted mule (150 spindles).

The Saco-Lowell Shops built and installed a ring spinning frame of 60 spindles for worsted yarns equipped with individual General Electric Company's motor and a Reeves Variable Speed Transmission.

Twelve turbo humidifier heads automatically controlled by a humidity regulator have been furnished by the G. M. Parks Company, Fitchburg, Mass. The compressed air for these heads is supplied by an Ingersoll-Rand 8 by 8 steam-driven air compressor.

For the purpose of determining the physical properties of fibers, yarns, and fabrics there has been installed a Textile Testing Laboratory where there are the necessary microscopes and micrometers, a skein-testing machine, and electric conditioning oven made by the Emerson Apparatus Company of Boston; single yarn and fabric strength-testing machines made by G. R. Smith & Company, Bradford, Eng.; a strength-testing machine, capacity 500 kilograms, for testing twines and fabrics; a fiber-testing machine for testing fibers and fine yarns with capacity, 1 gram to 1.5 kilograms; a yarn strength-testing machine with capacity 1,000 to

5,000 grams; and a yarn strength testing machine with capacity 5 to 30 kilograms, all of which have been made by Louis Schopper, Leipzig, Germany. Besides these we have a standard yarn and fabric testing machine as made by Henry L. Scott & Company of Providence, R. I., and a Mullen Tester. For the automatic control of temperature and humidity there has been installed by the American Moistening Company, of Boston, one of its automatic humidity and temperature regulators.

Design and Power Weaving Department.—In the fabric analysis section there has been provided chemical balances made by Voland & Sons and Christian Becker, necessary twist testers, microscopes, reels, etc., as well as a Torsion calculation balance made by the Torsion Balance Company of New York.

In the warp preparation department there has been installed by the Saco-Lowell Shops one of its spoolers, besides a warper and a slasher for preparing cotton warps; a beamer by T. C. Entwistle Company of Lowell, a 400-end improved Draper warper furnished by the Draper Corporation of Hopedale, Mass. The Whitin Machine Company, Whitinsville, Mass., has supplied a 180-spindle, long chain quiller, and the Johnson & Bassett Company, Worcester, Mass., a quiller of its make. The Universal Winder Company has supplied a winder for cop and bobbin winding and an 8-spindle doubler.

The woolen and worsted warp preparation department contains two 40-end Jack spoolers, two spool racks for 12 spools each, one pattern dry frame dresser, one pipe and cylinder dresser, one 60-inch reel, one 82-inch reel, and one double head beamer, all supplied by the Davis & Furber Machine Company of North Andover, Mass.

The Weaving Department contains four looms supplied by the Draper Corporation of Hopedale, Mass., which include a plain Northrup, an 8-harness corduroy, an improved Northrup, a Northrup with dobby. The Stafford Loom Company of Readville, Mass., has installed one plain, one cam, one dobby loom and one broad sheeting loom, all equipped with individual motors; the Whitin Machine Works, Whitinsville, Mass., a side cam twill, a plain print cloth loom, equipped with Kip-Armstrong electric warp stop motion; the Kilburn & Lincoln a plain loom; Lewiston Machine Company a 4-harness side cam and a bag loom; Crompton & Knowles Loom Works a jean loom and a plain loom with individual drive. Four of these looms are equipped with Abbott cleavers made by the Abbott Wire and Cast Steel Warp Cleaving Company, Lisbon Falls, Maine. The Hopedale Manufacturing Company of Milford, Mass., has recently installed one of its high speed looms with individual motor.

The fancy loom section includes a Stafford Ideal 16-harness automatic shuttle-changing loom, a Whitin 20-harness dobby loom, and the following furnished by the Crompton & Knowles Loom Works: Knowles gingham 4 by 1 boxes, Crompton gingham 4 by 1 boxes, one Crompton towel 2 by 1 boxes, two Terry towel and one huck towel looms, a 16-harness lappet loom, a 20-harness dobby 4 by 1 boxes, fancy leno loom, and a Crompton fancy cotton single cylinder 20-harness dobby.

The woolen and worsted section contains a Knowles 20-harness Gem, a Crompton 24-harness worsted 4 by 4 boxes, a Crompton 6 by 1 double cylinder 20-harness dobby, one heavy 20-harness 4 by 4 boxes, one 20-harness and one 25-harness blanket, seven intermediate woolen 25-harness 4 by 4 boxes and two 90-inch 25-harness heavy woolen looms.

The Jacquard loom section includes one Stafford silk loom, 1,200-hook, Halton head; one 400-hook, single-lift Schaum & Uhlinger Jacquard, mounted for 4-bank, narrow fabric loom; one Felix Tonnar German plush loom, with 400-hook Crompton & Knowles Jacquard head; one Skinner Brussels carpet loom, three-quarters wide, equipped with 1,280-hook Jacquard head presented by the Bigelow-Hartford Carpet Company, Clinton, Mass. The Crompton & Knowles Loom Works has furnished one Knowles fancy loom, single-lift Jacquard; one Knowles fancy loom, double-lift Jacquard; one Knowles fancy loom, Jacquard tied up for leno, one Knowles ingrain carpet loom, 4 by 4 boxes, one Knowles loom, 4 by 4 boxes, 54-inch, with 600-hook, double-lift, double-cylinder McMurdo Jacquard head, tied up for damask napkin designs, one Crompton ingrain carpet loom, 4 by 4 boxes, one Crompton & Knowles 72-inch tapestry loom, with 2,600-hook Halton Jacquard head, one 840-hook, double-lift, single-cylinder Jacquard on Crompton & Knowles

4-bank ribbon loom, one 800-hook, double-lift Knowles Gem silk brocade Jacquard machine, 4 by 4 boxes.

The silk loom section includes one Stafford silk loom, 20-harness dobby, 2 by 1 box motion, sliding bar warp stop motion, filling feeler, extended beam stands motor drive; one Crompton & Knowles silk loom, roller bearings, 4 by 4 box motion, 20-harness head motion, individual motor drive.

For the purpose of card cutting there has been furnished one Jacquard fine index card-cutting machine by John Royle & Sons, Paterson, N. J.; one Jacquard French index card-cutting machine by the same concern, and one Jacquard French index card-cutting machine presented by the Bigelow-Hartford Carpet Company, Lowell, Mass.

Chemistry and Dyeing Department.—The Chemistry Laboratory consists of one to give instruction in General Chemistry and Qualitative Analysis and provides facilities to take 120 students. The Quantitative Laboratory takes care of some 50 students and contains the necessary drying closet, steam bath, electrolytic table, with ample facilities to provide distilled water through the use of a Barnstead Water Still. The Balance Room, which is adjacent to the laboratory, has eleven analytical balances made by such concerns as Christian Becker, Eimer & Amend, and H. L. Becker's Sons & Company. The Organic Laboratory has facilities to take care of approximately 25 students having the necessary equipment required in the preparation of basic organic compounds and instruments used in the manufacture of dyes such as autoclaves, electric and gas combustion furnaces.

For the purpose of carrying on photographic and microscopic experiments and analyses the laboratory has been provided with equipment which includes besides the Bausch & Lomb microscopes, a polariscope made by Franz Schmidt & Haensch, Berlin, Germany, a Gaestner spectroscope, a Bausch & Lomb Model G photo-micrographic apparatus equipped with D. D. S. microscope and all necessary apparatus, a Kodak projection printer. In the dark room there has been placed a piece of apparatus for determining the relative fading powers of various light sources. Besides the common gas and electric lamps there is installed a solar determinator, made by the Atlas Electric Company, Chicago, Ill., also a 400-watt Nela Trutint and color-matching unit made by Nela Specialties Division, Cleveland, Ohio.

The Chemical Museum has been provided with cases and representative dyestuffs all furnished by various dyestuff manufacturers of this country and abroad. This offers an unparalleled opportunity for students to study and experiment with almost all of the representative dyes which are used in the textile industry.

The Experimental Dyeing Laboratory is equipped with individual benches, small dyeing apparatus, reels, balances, apparatus for dye testing, such as frames for exposing dyed material to light, and a complete collection of dyestuff samples and sample cards. There are also fifty-six steam coil experimental dyeing baths, a drying chamber and ageing chamber, in addition to a Hurricane Dryer, Class D, made by the Philadelphia Drying Machinery Company, Pennsylvania. Adjacent to the Experimental Dyeing Laboratory there has been provided a well-lighted room for the storage of a great variety of dyestuffs. Steel shelving has been arranged so that the samples are easy of access. All samples are catalogued in a card file, thus facilitating their use.

The Experimental Printing Laboratory is equipped with a calico printing machine, made by Mather & Platt, Manchester, Eng., an iron-jacketed steaming chamber from A. Edmeston & Son, Patricroft, Eng., and a set of steam-jacketed copper kettles.

The Fuel and Oil Analysis Laboratory contains the following equipment for the analysis of coals and fuels: a Mather bomb calorimeter, with complete outfit, an Emerson bomb calorimeter, with complete outfit, a Parr calorimeter, an Abbé refractometer, a Torsian viscosimeter, a Tagliabue viscosimeter, a Tagliabue cold test apparatus, a Pensky Martin oil tester, a New York State oil tester, a Sartorius specific gravity balance, two Becker analytical balances, gas muffle furnace, Kny-Scherer oil tester, a Graefe gas calorimeter, an Orsat gas analysis apparatus, laboratory tables, lockers, and hoods.

The Industrial Chemistry Laboratory contains the following: one filter press,

Type E. T. Shriver & Company; a single-acting triplex plunger pump, Goulds Manufacturing Company; a vacuum drying apparatus, a surface condenser, a Packard vacuum pump, Norman Hubbard's Sons; a vacuum evaporator, Swenson system, American Foundry and Machine Company; a centrifugal, C. H. Chavant & Company; a double jar mill, F. I. Stokes & Company.

To give instruction in dyeing on a basis which is more comparable with commercial practice there is provided a laboratory which includes the following equipment: a small kier, fitted with E. D. Jefferson's circulating device, an electrolyzer for manufacturing bleaching solutions, the National Laundry Machine Company, Dayton, Ohio; a Permutit filter, the Permutit Company, New York City; a mercerizing machine, a raw stock dyeing machine, Klauder-Weldon Dyeing Machine Company, Yardley, Pa.; a yarn dyeing machine, Klauder-Weldon Dyeing Machine Company; a jig dyeing machine, the Textile-Finishing Machine Company, Providence, R. I.; a set of drying cans by the same concern; a chain dyeing machine, T. C. Entwistle Company, Lowell, Mass.; a raw stock drying table, Proctor & Schwartz, Philadelphia, Pa.; a padding mangle, Arlington Machine Works, Arlington, Mass.; a hydro-extractor, W. H. Tolhurst & Son, Troy, N. Y.; a Psarski experimental dyeing machine, a Hussong experimental dyeing machine, equipped for raw stock or yarns, a Rodney Hunt sample piece dyeing machine, equipped with an automatic temperature and pressure-regulating apparatus, made by C. J. Tagliabue Manufacturing Company, Brooklyn, N. Y. The Franklin Process Company, Providence, R. I., have furnished a 25-pound bronze dyeing machine. Of the various dye tubs, one is equipped with a Monel metal lining to withstand the action of various chemicals and dyes.

Finishing Department.—The Woolen and Worsted section includes a 4-string washer, a fulling mill, and a combination fulling and washing mill for jersey fabrics, furnished by the Rodney Hunt Company, Orange, Mass.; a sample fulling mill, a kicker mill, furnished by James Hunter & Company, North Adams, Mass.; an up and down dry gig, a rolling and stretching machine, an up and down wet gig, a steam finishing machine, a 60-inch, 3-burner singeing machine, adapted for cotton, silk or worsted goods, a 2-cylinder double-acting brushing machine, a 60-inch, 4-cylinder sanding and polishing machine, furnished by Curtis & Marble Machine Company, Worcester, Mass.; a mantle steaming and air cooling machine, donated by Curtis & Marble Machine Company, and equipped with a direct connected motor and a Nash pump; a 66½-inch motor driven, single woolen shear, equipped with list saving motion, donated by Curtis & Marble Machine Company; a 6-4 double shear, an A. W. C. measuring and weighing machine, furnished by Parks & Woolson, Springfield, Vt.; a dewing machine, a 6-4 Voelker rotary press, furnished by G. W. Voelker & Co., Woonsocket, R. I.; a tentering and drying machine furnished by John Heathcote, Providence, R. I., a single crabbing machine, H. W. Butterworth & Son, Philadelphia, Pa.; a 72-inch woolen napper donated by Davis & Furber, North Andover, Mass.; a 32-inch basket hydro-extractor, W. H. Tolhurst, Troy, N. Y.; a Lintz & Eckhardt cloth numbering machine, from Durbrow & Hearne Company, New York; a steam press for underwear, United States Hoffman Company, Syracuse, N. Y.; a sewing machine, Birch Brothers, Somerville, Mass.; a trimming and overseaming machine, The Merrow Machine Company, Hartford, Conn.

The Cotton section includes a 40-inch inspecting and brushing machine, a 44-inch No. 25 railway sewing and rolling machine, a 44-inch cotton shearing machine, Type No. 34, a 44-inch No. 3 steam calender rolling machine, a 40-inch cloth folder, a 40-inch winder and measurer, a set of 44-inch shear blades for grinding purposes, furnished by Curtis & Marble Machine Company, Worcester, Mass.; a 48-inch No. 4 opening, sewing and rolling machine, a No. 1 hand power portable railway sewing machine, furnished by Dinsmore Manufacturing Company, Salem, Mass.; a 40-inch 4-tank open soaping machine equipped with patent flushing rolls, brass and rubber squeeze rolls and spiral openers, furnished by Birch Brothers, Somerville, Mass.; an 84-inch 36-roll, ball bearing, double acting napper, equipped with a 7½-horsepower General Electric motor drive, furnished by Davis & Furber, North Andover, Mass. (the ball bearings were donated by the Fafnir Bearing Company, New Britain, Conn.); an 8-inch belt lacer furnished by the Clipper Belt

Lacer Company of Grand Rapids, Mich.; a 40-inch, 3-roll water mangle, with husk and brass rolls and usual attachments and equipped with a 48-inch Mycock scutcher, and a 40-inch Mycock cloth expander made by Thomas Leyland & Company, Boston; a 40-inch, 2-roll starch mangle, a 40-inch upright drying machine with 10 copper cylinders equipped with Files dry can system, Files Engineering Company, Inc., Bridgeport, Conn.; a 40-inch sprinkler, a 40-inch, 5-roll Universal calender with chasing attachment and equipped with a 40-inch Mycock cloth expander, a pasting table with plate, furnished by the Textile-Finishing Machinery Company, Providence, R. I.; a 16 by 24 inch bronze-covered stretcher for the drying cans, C. A. Luther & Company, Providence, R. I.; a 40-inch double bristle stretcher for drying cans, American Finishing Machinery Company, Boston, Mass.; a trimming and overseaming machine, The Merrow Machine Company, Hartford, Conn.; a 40-inch Tommy Dodd starch mangle, and a 44-inch, 50-foot vibratory tentering machine, H. W. Butterworth & Sons Company, Philadelphia, Pa. This machine is directly driven by a 7½-horsepower variable speed motor and is equipped with a Schwartz automatic electric guider, made by L. H. A. Schwartz & Company, Boston, Mass.

Engineering Department.—The Steam Engineering Laboratory contains the following equipment arranged for experimental purposes: A 50-horsepower Allis-Chalmers Corliss steam engine direct connected to an Alden absorption dynamometer, and piped to exhaust its steam to the atmosphere, to a Wheeler surface condenser or to the Kerr turbine; a Kerr seven-stage turbine driving directly a 25-kilowatt Richmond Electric Company's alternating current generator and piped to exhaust either to the atmosphere or the condenser. It may be operated either as high pressure or low pressure turbine, and the generator has special connections to illustrate various commercial phases. In addition there are a 4 by 6 Deane triplex power pump, two 2-inch centrifugal pumps made by Lawrence Machine Company, Lawrence, Mass., a Clayton air compressor and necessary tanks, scales and measuring instruments. For the measurement of flow of air there are a steam-driven Sturtevant fan and a motor-driven Massachusetts fan with heater combined for heating and drying experiments.

The Electrical Engineering Laboratory consists of two sections, one of which is devoted to instruction in the generation and transmission of power, and contains the necessary switchboard and instruments to control a 25-kilowatt alternating current turbo generator and a 15-kilowatt motor generator set arranged to supply either direct or alternating current. In addition there are a 24-horsepower direct current Allis-Chalmers motor and a 10-horsepower direct current General Electric motor, also a 10 and a 7.5 horsepower General Electric alternating current motor besides a General Electric 3-kilowatt rotary transformer and three Westinghouse stationary transformers. The other section of the laboratory is known as the instrument laboratory and is for the purpose of giving instruction in the measurement of current voltage, resistance, and in the calibration of instruments. It contains a 5-kilowatt Crocker-Wheeler balancer, a 160-ampere hour storage battery, a 5-kilowatt 220-volt to 440-volt General Electric transformer, a Westinghouse portable wattmeter with current and potential transformers, three wattmeters, two ammeters and a voltmeter, all of the General Electric portable alternating current type, a 30-volt alternating current Roller Smith voltmeter, a 5 to 10-scale Weston ammeter (electro-dynamometer type), a Weston millivoltmeter with 2, 20, 50 and 200 ampere shunts, three 250-volt direct current Weston voltmeters, a 150-ampere, two model, 45 two model 260 Weston portable ammeters, a Weston model 260 voltmeter, a Thompson 50-ampere recording wattmeter, a General Electric rotating standard wattmeter, two General Electric induction type watt hour meters, an Esterline portable curve drawing wattmeter, a 100-ampere Leeds & Northrup Standard Resistance, a Leeds & Northrup Ayrton shunt, a Weston laboratory standard voltmeter with 600-volt multiplier, a Leeds & Northrup potentiometer, a D'Arsonval wall type galvanometer, a Wheatstone bridge with galvanometer, a slide wire bridge and electro-dynamometer, Weston Standard cell, potential phase shifter, a standard Leeds & Northrup photometer with Lummer-Brodhun screen, and Macbeth illuminometer made by the same concern.

Machine Shop.—The equipment of the machine shop is as follows: Four

standard engine lathes, 13-inch swing, 6-foot bed, from Flather & Company, Nashua, N. H.; three standard engine lathes, 14-inch swing, 6-foot bed, from Flather & Company, Nashua, N. H.; a standard engine lathe, 15-inch swing, 6-foot bed, from F. E. Reed Company, Worcester, Mass.; an engine lathe, 18-inch swing, 10-foot bed, from Flather & Company, Nashua, N. H.; an engine lathe, 18-inch swing, 6-foot bed, from Champion Tool Works, Cincinnati, Ohio; a standard engine lathe, 15-inch swing, 6-foot bed, from S. H. Putnam Sons, Fitchburg, Mass.; five speed lathes, 17-inch swing, 5-foot bed, from J. G. Blount, Everett, Mass.; one No. 1 Universal milling machine, with all three feeds automatic, from Kempsmith Manufacturing Company, Milwaukee, Wis.; one 24 by 24 inch, 6-foot planer, from the Mark Flather Planer Company, Nashua, N. H.; one 23-inch upright drill, with back gears and power feed, from J. E. Snyder & Son, Worcester, Mass.; one 14-inch single sensitive drill, from the Stanley Manufacturing Company, Lawrence, Mass.; one No. 1 Universal grinder, from Landis Tool Company, Waynesboro, Pa.; one 20-inch wet tool grinder, from J. G. Blount, Everett, Mass.; one 12-inch, 2-wheel dry grinder, from J. G. Blount, Everett, Mass.; an American twist drill grinder, from the Heald Machine Company, Worcester, Mass.; one Type 1B portable electric grinder from the Cincinnati Electric Tool Company, Cincinnati, Ohio; one 30-inch grindstone and frame, from the Athol Machine Company, Athol, Mass.; a single spindle centering machine, from D. E. Whiton Machine Company, New London, Conn.; one 15-inch shaper, from Potter & Johnson, Pawtucket, R. I.; one power hacksaw, from the Fairbanks Company, Boston, Mass.; one cold saw, from John T. Burr & Son, Brooklyn, N. Y.; one Eureka metal power saw, Manning, Maxwell & Moore; one Type CC electric drill, Cincinnati Electric Tool Company; one Universal milling attachment for Kempsmith milling machine, Taylor Machinery Company; one Hisey Type B ½-horsepower tool post grinder, Taylor Machinery Company; one No. 2 Cory bench straightener, Manning, Maxwell & Moore; one No. 3 Universal cutter and reamer grinding machine, Browne & Sharpe; a well-equipped tool room containing a selected stock of the best makes of small tools, such as drills, taps and dies, milling cutters, reamers, gauges, micrometers, etc.

Power, Light, Heat and Ventilating Plant.—In the powerhouse there is located the main power-generating apparatus for supplying light, heat and power to all departments of the Institute. The equipment here consists of: two 250-horsepower Heine water tube boilers, equipped with Perfection grates, a 300-horsepower Aultman & Taylor horizontal water tube boiler, equipped with United States rocking grates, two boiler feed pumps—one a Knowles and the other a Deane—a 40,000-pound Cochrane metering open-feed heater, which is provided with a Lea recorder, and a Cochrane oil extractor heats and measures all feed water, a 3-inch Venturi meter in feed line with indicating manometer as made by the Builders Iron Foundry, Providence, R. I. In the Engine Room are located: a Payne 14 by 14 automatic high speed engine, 125-horsepower direct connected to 75-kilowatt, 220-volt, direct-current Bullock generator, a 9½ by 11 Nash gas engine of 50-horsepower, 4-cycle type, with speed-regulating clutch and a "hit and miss" governor, direct connected to a 30-kilowatt, 220-volt, direct-current Bullock generator, a 65-kilowatt motor generator set, consisting of a direct current motor and an alternating current generator. This unit may be run either A. C. to D. C. or D. C. to A. C., and was made by the Westinghouse Electric and Manufacturing Company. A steam-driven Ingersoll-Rand 8 by 8 air compressor, for use with Turbo heads, installed in the French Spinning Department by the G. M. Parks Company, Fitchburg, Mass., a 5½ to 6 motor-driven air compressor, with 20 cubic foot storage tank for use in starting Nash gas engine, a Cross oil filter. The station switchboard is of marine-finished slate, 90 inches in height, and consists of three generator panels and two circuit panels.

The powerhouse is connected with the main school buildings by a tunnel through which all wires, steam and water pipes are carried. The steam pipes supply heat to the buildings by means of direct radiation, and by means of the Sturtevant double duct heating and ventilating system located in the basement of Southwick Hall, and by the Sturtevant fan and heater located in the basement of Kitson Hall. Direct-driven exhaust fans are placed on the roof of Southwick Hall and in the basement laboratories.

GRADUATES WITH TITLES OF THESES

June 10, 1930

Bachelor of Textile Chemistry

Morris Arnold Barsky, Dorchester, Mass. "Application of the Azoic Dyes to Viscose."

Willard Alvah Colby, Jr., Bradford, Mass. "Investigation of the Methods for the determination of small amounts of copper in textile materials to be rubberized." (Thesis with Gerald F. McDonald.)

Arthur Francis Gallagher, Lowell, Mass. "The dyeing of animal fibers with the Azoic dyes."

George John Greendonner, Jr., Stafford Springs, Conn. "The analysis of spent wool scouring liquor."

Herman Peter Gross, Lowell, Mass. "A practical outline for a comprehensive study of the dry-cleaning industry."

Bliss Morris Jones, Lexington, Mass. "Study of the effect of alkali or acidity (pH) upon the tensile strength of cotton cloth." Thesis with Samuel I. Kolsky.

Samuel Irving Kolsky, Lawrence, Mass. Thesis with Bliss M. Jones.

Henry Konieczny, Dracut, Mass. "A study of the action of wetting-out agents."

Gerald Francis McDonald, Lowell, Mass. Thesis with Willard A. Colby.

Francis Patrick McGee, Lowell, Mass. "Study of the application of vat dyes upon cotton and celanese."

Earle Raymond McLean, Haverhill, Mass. "Some textile applications of chemical microscopy and micro-chemical analysis."

Alfred Charles Stacey, Andover, Mass. "The permanent mothproofing of woolen and worsted fabrics."

John Weeden Stewart, Lowell, Mass. "The determination of some physical properties of textile fibers by microscopical methods."

Leon Topjian, Lowell, Mass. "Kier boiling compounds and their relative effects."

Bachelor of Textile Engineering

Earl Beeman, Quincy, Mass. "A study of the possibility of using oscillatory circuits for measuring the evenness of textile materials."

Richard Sumner Cleveland, East Pepperell, Mass. "The effect of twist upon the strength and elasticity of rayon yarns."

Kirke Harold Dunlap, Jr., Lowell, Mass. "The development of an instrument for measuring lustre."

Harmon Howorth, Lowell, Mass. "A comparison of yarns spun from cotton processed by the one and two process systems of picking."

Emanuel Arthur Kostopoulos, Lowell, Mass. "A determination of the relation between yarn strength and fabric strength."

Maharaj Krishan, Montgomery, India. "A study of the effect of twist upon the strength and the elasticity of a cotton yarn."

Walter Archibald Robbins, Lowell, Mass. "The development of an automatic device for measuring and recording the tension in yarns during spinning."

Diploma Graduates

Cotton Manufacture

Hsiung–Yuan Tang, Wusih, China. "A study of the comparison of cotton yarns produced on three long draft systems and on the regular system."

Wool Manufacture

Allen Frank Garner, Kezar Falls, Me. "The manufacture of an alpaca topcoating."

Thomas Sheridan Sadler, Billerica, Mass. "The manufacture of a worsted suiting."

Textile Design

Joseph Raddin Carleton, Haverhill, Mass. "The making of a designer's blanket of eight different drawn-in sections in the warp with the resultant effects obtained from chains of each section."

Prizes awarded in June, 1930

Textile Colorist Award of $100 offered to a member of the graduating class whose thesis, based upon his personal researches and experiences, is of the greatest practical value to the dyeing, bleaching, or textile finishing industries. To *Morris Arnold Barsky.*

The Medal of the National Association of Cotton Manufacturers awarded to the student taking course in Cotton who maintains the highest average in scholarship throughout this course. To *Richard Sumner Cleveland.*

Louis A. Olney Prizes (in the form of books).

$20 to the regular student in the Chemistry and Textile Coloring course who shall present the best thesis preparatory to graduation. To *Bliss Morris Jones* and *Samuel Irving Kolsky* (joint thesis). Honorable mention, *Earle Raymond McLean.*

$10 to the regular student of the Chemistry and Textile Coloring course who shall be considered as having attained the highest scholarship during his second year. To *Stanley Squire Hockridge.*

$5 to the regular student of the Chemistry and Textile Coloring course who shall be considered as having attained the second highest scholarship during his second year. To *Joseph James Pizzuto, Jr.* Honorable mention, *Lorne Fernley Howard* and *Herbert Eugene Meinelt.*

$10 to the student taking the regular Chemistry and Textile Coloring course who shall be considered as having attained the highest scholarship in first-year Chemistry. To *Henry Alfred Wells, Jr.*

$5 to the student taking the regular Chemistry and Textile Coloring course who shall be considered as having attained the second highest scholarship in first-year Chemistry. To *Raymond Lewis Matthews.* Honorable mention, *Gerald Adelbert Robillard* and *David Henry Turcotte.*

Scholarships

The Textile Color Card Association Scholarship.—For the purpose of promoting interest in color harmony and color blendings for textile material, this association offered in June, 1930, a scholarship providing free tuition to a member of the class of 1932, the scholarship to continue for two years in accordance with specified conditions named in the offer. Awarded to *Edward Lucien Golec.*

Herbert A. Currier Scholarship.—$100 given by Herbert A. Currier, of the Class of 1906, to a student selected by the faculty of the Institute, the following conditions to be considered in making the selection: scholastic standing, financial need, and ability in promoting student activities in school life. To *Edward Joseph Allard.*

REGISTER OF DAY STUDENTS

Candidates for Degree

Class of 1931

	Home Address	Lowell Address
Allard, Edward Joseph, IV,	Lowell, Mass.	116 Ennell Street
Bagshaw, Herbert Arthur, VI,	Lowell, Mass.	92 Jenness Street
Bradford, William Swanton, VI,	Andover, Mass.	———
Burtt, Joseph Frederic, VI,	Lowell, Mass.	23 Grace Street
Carbone, Alfred John, IV,	Haverhill, Mass.	———
Casey, Francis Harold, IV,	Roslindale, Mass.	159 White Street
Danahy, Arthur Joseph, IV,	Lowell, Mass.	37 Clark Street
Duggan, Paul Curran, IV,	Lowell, Mass.	58 D Street
French, Wallace Howe, IV,	Lowell, Mass.	636 Rogers Street
Grant, Alfred Thomas, IV,	Methuen, Mass.	526 Moody Street
Hale, Ralph Edgar, IV,	West Newbury, Mass.	272 Merrimack Street
Hall, Stanley Arundel, IV,	Haverhill, Mass.	Phi Psi House
Hardman, Joseph Edwin, IV,	Lowell, Mass.	51 Westchester Street
Hosmer, Frank Barbour, IV,	Lowell, Mass.	226 Gibson Street
Ivers, Gerald Anthony, IV,	East Chelmsford, Mass.	———
Japek, Julius, IV,	Lowell, Mass.	74 Eleventh Street
Johnson, Norman Albin, IV,	Deep River, Conn.	Omicron Pi House
Lifland, Abraham, IV,	Roxbury, Mass.	63 Westford Street
Loveless, Everton Hanscom, VI,	Melrose, Mass.	Omicron Pi House
Maher, Margaret Mary, IV,	Lowell, Mass.	R. 874 Central Street
McAllister, Gordon Alger, IV,	North Billerica, Mass.	———
McDonald, John Joseph, IV,	Lowell, Mass.	208 Mount Hope Street
Meady, Benjamin Balch, IV,	Lexington, Mass.	159 White Street
Orlauski, Anthony, IV,	Haverhill, Mass.	———
Parker, John George, Jr., IV,	Chelmsford, Mass.	———
Peterson, Eric Arthur, IV,	Lowell, Mass.	71 Winthrop Avenue
Piligian, Hiag Nishan, IV,	Springfield, Mass.	37 Varney Street
Quigley, Gerald Francis, IV,	Lowell, Mass.	51 Crawford Street
Rawlinson, Richard William, VI,	Lowell, Mass.	430 Pine Street
Russell, Harold William, VI,	Sanford, Me.	90 Chestnut Street
Stewart, Alexander, VI,	Andover, Mass.	———
Toher, Francis Luke, IV,	Lowell, Mass.	524 Moody Street
Wallace, Max Joseph, IV,	Malden, Mass.	117 Bowers Street
Wang, Yun-Cheng, VI,	Shanghai, China	53 Mount Hope Street

Class of 1932

Armitstead, Russell Arthur, IV,	Lowell, Mass.	628 Wilder Street
Barry, Marie Gertrude, IV,	Lowell, Mass.	31 Hoyt Avenue
Bertrand, Arthur Leon, IV,	Lowell, Mass.	27 West 5th Street
Campbell, Allan, Jr., VI,	South Boston, Mass.	37 Varney Street
Churchill, Charles Whittier, Jr., VI,	Lowell, Mass.	214 Third Street
Dudley, Albert Richard, VI,	Lowell, Mass.	126 Coburn Street
Ferguson, Thomas Dickson, Jr., VI,	Lowell, Mass.	Omicron Pi House
Gleklen, Leo, IV,	Lynn, Mass.	117 Bowers Street
Glowacki, Joseph, VI,	Andover, Mass.	———
Greene, William Joseph, Jr., IV,	Edgewood, R. I.	Phi Psi House
Hegy, Gerard John, VI,	Holyoke, Mass.	106 Crawford Street
Hockridge, Stanley Squire, IV,	North Adams, Mass.	Omicron Pi House
Howard, Lorne Fernley, IV,	North Chelmsford, Mass.	———

King, Daniel Joseph, IV, Lowell, Mass.	158 Pleasant Street
Lathrop, John Dunn, IV, Lowell, Mass.	37 Varney Street
Lifland, Bessie, IV, Roxbury, Mass.	63 Westford Street
McDougall, Francis Gerard, VI, Lowell, Mass.	637 Broadway
McQuaid, Barton Mathewman, IV, North Billerica, Mass.	———
Meehan, John Joseph, IV, Lowell, Mass.	35 Varney Street
Meinelt, Herbert Eugene, IV, Lawrence, Mass.	———
Moran, Edward Francis, IV, Lowell, Mass.	75 Beacon Street
Pizzuto, Joseph James, Jr., IV, Pittsfield, Mass.	Phi Psi House
Savard, Aime Albert, IV, Lowell, Mass.	311 Mammoth Road
Sawyer, Henry Severance, VI, Dalton, Mass.	———
Spalding, Arthur Ovila, IV, Lowell, Mass.	84 D Street
Spaulding, Ned, VI, Hudson, N. H.	———
Stearns, Kenneth Lawrence, IV, Lowell, Mass.	43 Grace Street
Walker, Samuel, J. IV, East Liverpool, Ohio	37 Varney Street
Wojas, Stanley Edward, IV, Lowell, Mass.	24 Ray Court

Class of 1933

Babigan, Edward, IV, Lowell, Mass.	121 Bellevue Street
Bachner, Simon, IV, Roxbury, Mass.	———
Birenbaum, William, IV, Haverhill, Mass.	117 Bowers Street
Birtwell, John Lincoln, IV, East Chelmsford, Mass.	———
Brosnan, James Henry, IV, Lowell, Mass.	100 White Street
Burke, James Edward, IV, Lowell, Mass.	77 Durant Street
Custer, Herbert James, IV, Lowell, Mass.	4 Hildreth Street
Daley, Charles Lincoln, IV, Lowell, Mass.	239 Stevens Street
Dempsey, Philip Edward, IV, Monson, Mass.	43 Plymouth Street
Donohoe, Edward Joseph, VI, Lowell, Mass.	49 Butterfield Street
Forsythe, George, VI, Andover, Mass.	Omicron Pi House
Gifford, Alden Ives, Jr., VI, Lowell, Mass.	18 Marlborough Street
Glowienski, Mitchell, IV, Lowell, Mass.	198 West Sixth Street
Hallissy, John Joseph, VI, Manchester, Mass.	Phi Psi House
Kokoska, Michael George, VI, Lowell, Mass.	120 Lakeview Avenue
Lawson, Russell Munroe, VI, Andover, Mass.	———
Lifland, Moses, VI, Roxbury, Mass.	———
Markarian, Haig, IV, Lowell, Mass.	103 Lawrence Street
Matthews, Raymond Lewis, IV, Gardner, Mass.	137 Riverside Street
Morse, Robert Turnbull, VI, Lowell, Mass.	466 Beacon Street
Moses, Nicholas, IV, Lowell, Mass.	83 Mount Vernon Street
Murphy, John Joseph, IV, Lowell, Mass.	124 Liberty Street
Raymond, Frank Everett, Jr., VI, Ipswich, Mass.	3 Belmont Street
Recher, Theodore, VI, North Providence, R. I.	137 Riverside Street
Robillard, Gerald Adelbert, IV, Lowell, Mass.	124 Riverside Street
Shapiro, Simon, VI, Lowell, Mass.	84 Cambridge Street
Turcotte, David Henry, IV, Lowell, Mass.	523 Fletcher Street
Wells, Henry Alfred, Jr., IV, Elizabeth, N. J.	37 Varney Street
Wilkie, Robert Campbell, VI, Newton Centre, Mass.	137 Riverside Street
Young, Edmund Joseph, Jr., IV, Lowell, Mass.	545 School Street

Class of 1934

Alger, Herbert Wendell, Jr., IV, West Bridgewater, Mass.	272 Merrimack Street
Allen, Grover Stanley, IV, Haverhill, Mass.	———
Batchelder, William Brewster, VI, Lowell, Mass.	20 Walden Street
Beigbeder, Edgar Raymond, IV, Roslindale, Mass.	———

Bradford, Edward Hosmer, VI, Andover, Mass.	———
Bukala, Mitchell John, IV, Lowell, Mass.	3 Osgood Avenue
Cadgene, Jacques Paul, IV, Englewood, N. J.	123 Riverside Street
Connor, John Francis, IV, Lowell, Mass.	12 Belmont Street
Cowan, Raymond Bernard, IV, Haverhill, Mass.	———
Crane, Eugene Francis, VI, Lowell, Mass.	517 Westford Street
Diehl, Fred Anton, VI, Garfield, N. J.	272 Merrimack Street
Duggan, Thomas Francis, VI, Wakefield, Mass.	———
Dunlap, Parker, VI, Lowell, Mass.	58 Hanks Street
Dunn, Austin Pember, VI, Shirley, Mass.	Omicron Pi House
Fox, David James, VI, Lowell, Mass.	359 Beacon Street
Garner, John William, IV, Kezar Falls, Me.	Omicron Pi House
Genest, Roland Napoleon, IV, Lowell, Mass.	75 Westford Street
Gillespie, Francis Clifford, IV, North Andover, Mass.	———
Graham, Robert Theodore, IV, North Andover, Mass.	———
Gregory, Robert Crockett, VI, Rockland, Me.	63 Varnum Avenue
Harris, Frederick Harry, VI, Lowell, Mass.	66 Princeton Street
Henderson, Robert James, IV, Swampscott, Mass.	272 Merrimack Street
Hevey, John Bernard, VI, Lowell, Mass.	66 Porter Terrace
Jennings, Edward Joseph, VI, Lowell, Mass.	859 Lawrence Street
Kidder, Glen Mortimer, IV, Ayer, Mass.	———
King, John Joseph, Jr., VI, Lowell, Mass.	130 Fort Hill Avenue
Kiszka, Thaddeus Stanislaw, VI, Lowell, Mass.	211 Lakeview Avenue
Lauder, Robert William, VI, Haverhill, Mass.	———
Leblanc, Gerald Alderic, VI, Lowell, Mass.	86 White Street
Leslie, Kenneth Everett, IV, Haverhill, Mass.	———
Lynn, Michael John, IV, Lowell, Mass.	59 Westford Street
McPeake, Frank Joseph, Jr., VI, Lexington, Mass.	———
Mamber, Solomon, VI, Brooklyn, N. Y.	272 Merrimack Street
Moody, Leon Eugene, IV, Lowell, Mass.	113 Ludlam Street
Morrison, Roland Charles, IV, Lowell, Mass.	1073 Lakeview Avenue
Murphy, Charles Joseph, IV, Lowell, Mass.	197 Christian Street
O'Neil, John Arthur, VI, Lynn, Mass.	142 Riverside Street
Phelan, Leonard John, IV, Ipswich, Mass.	142 Riverside Street
Schaltenbrand, Alfred Leo, IV, Framingham, Mass.	37 Varney Street
Seamans, Daniel Maurice, VI, Franklin, N. H.	37 Varney Street
Silk, Edward Francis, VI, Bennington, Vt.	262 East Merrimack Street
Smith, Harold, IV, Lowell, Mass.	24 Belmont Street
Smith, William Arthur, Jr., VI, Gloucester, Mass.	Phi Psi House
Stevens, William Edwin, VI, West Warwick, R. I.	125 Mt. Washington Street
Sullivan, Joseph Michael, IV, Lowell, Mass.	28 Dunfey Street
Thomas, Benjamin, Jr., VI, Nashua, N. H.	———
Thomas, Henry Lester, VI, East Douglas, Mass.	———
Thomas, Robert Joseph, IV, Lowell, Mass.	24 Loring Street
Wynn, William Joseph, Jr., IV, Lowell, Mass.	4 Ames Place
Young, Aaron Slack, IV, Pepperell, Mass.	———

Diploma Students

Class of 1931

Babb, Charles Wilkes, Jr., II, Camden, Me.	142 Riverside Street
Daley, Raymond Joseph, II, Lowell, Mass.	239 Stevens Street
Hobbs, Aubrey Alonzo, I, Anniston, Ala.	142 Riverside Street
Kilmartin, John Joseph, I, Lowell, Mass.	62 Highland Avenue
Peary, John Ervin, III, Wilton, Me.	Omicron Pi House
Pero, Richard Omer, II, Methuen, Mass.	Omicron Pi House
Verry, Richard Morton, III, Salem, Mass.	11 White Street
Williams, Albert William, III, Lowell, Mass.	178 First Street

Class of 1932

Atkinson, Alan Alexander, II, Lowell, Mass.	77 Wilder Street
Donahue, Edward Emerson, II, Norwood, Mass.	Phi Psi House
Golec, Edward Lucian, III, Lowell, Mass.	117 Coburn Street
Stursberg, Laird, II, New York, N. Y.	18 Astor Street
Yung, E-Zung, I, Shanghai, China	53 Mount Hope Street

Class of 1933

Brown, William Alden, II, Norway, Me.	43 Plymouth Street
Cohen, Donald Berlove, II, Rochester, N. Y.	37 Varney Street
Crawford, John Thomas, II, Rockland, Mass.	43 Plymouth Street
Howard, Arthur Vincent, III, Lowell, Mass.	12 Third Ave.
Huyck, William Francis, II, Albany, N. Y.	43 Plymouth Street
Magidson, Eda Aaron, III, New York, N. Y.	90 Mount Vernon Street
Morse, Judson Pickering, II, Danvers, Mass.	43 Plymouth Street
Newell, Benjamin Chase, III, Derry, N. H.	137 Riverside Street
Penney, Cabot William, III, Methuen, Mass.	———

Special Students

Brady, Anamay Smith, III, Lowell, Mass.	233 Westford Street
Clark, Gerald Burrill, III, Corinna, Me.	215 Princeton Boulevard
David, Juan Falla, I, Manila, P. I.	486 Merrimack Street
Deren, Jacques, I, Pavilly, France	137 Riverside Street
Kapala, Theodore, IV, Lowell, Mass.	117 Coburn Street
Langloris, Ovila Eugene, III, Stottsville, Canada	41 Mount Vernon Street
Taft, David Russell, III, Oxford, Mass.	Omicron Pi House

ALPHABETICAL LIST OF GRADUATES

The following list has been corrected in accordance with information received previous to February 1, 1931. Any information regarding incorrect or missing addresses is earnestly solicited.

B.T.C. indicates the degree of Bachelor of Textile Chemistry; B.T.D. indicates the degree of Bachelor of Textile Dyeing; B.T.E. indicates the degree of Bachelor of Textile Engineering; D indicates a diploma; C indicates a certificate (covering a partial course only). Degrees were issued beginning with the year 1913.

Abbot, Edward Moseley, II, '04 (D). Vice-President, Abbot Worsted Company, Graniteville, Mass.
Abbott, George Richard, II, '08 (D). Andover, Mass.
Adams, Floyd Willington, VI, '16 (B.T.E.). 613 West Moss Avenue, Peoria, Ill.
Adams, Henry Shaw, I, '05 (D). Secretary and Treasurer, Eureka Cotton Mills, Chester, S. C.
Adams, Tracy Addison, IV, '11 (D). General Manager, Arnold Print Works, North Adams, Mass.
Albrecht, Charles Henry, IV, '17 (B.T.C.). Chemist, The Bell Company, Worcester, Mass.
Almquist, George John Edwin, I, '19 (D). Second Vice-President, Passaic-Bergen Lumber Company, Ridgewood, N. J.
Anderson, Arthur Illman, IV, '24 (B.T.C.). Associate, Department of Research, Laundry-owners National Association, Joliet, Ill.
Anderson, Arthur Julius, IV, '19 (B.T.C.). Salesman, National Aniline and Chemical Company, 40 Rector Street, New York City.
Anderson, Clarence Alfred, VI, '25 (B.T.E.). Cost Department, Butler Mills, New Bedford, Mass.
Anderson, Harold Robert, II, '26 (D). In charge of Research Laboratory, Abbot Worsted Company, Forge Village, Mass.
Annan, David, II, '23 (D). 105 Almont Street, Winthrop, Mass.
Arienti, Peter Joseph, IV, '10 (D). Chief Chemist and Dyer, Sayles Finishing Plants, Inc., Saylesville, R. I.
Arundale, Henry Barnes, II, '07 (D). In charge of Research Department, United States Testing Company, Inc., 1415 Park Avenue, Hoboken, N. J.
Atwood, Henry Jones, II, '23 (D). Assistant Superintendent, Daniels Manufacturing Company, East Brookfield, Mass.
Avery, Charles Henry, II, '06 (D). Died January, 1913.

Babigan, Raymond, IV, '24 (B.T.C.). Patent Examiner, United States Patent Office, Washington, D. C.
Bachelder, Charles Edward, IV, '24 (B.T.C.). Research Rayon Chemist, Tennessee Eastman Corporation, Kingsport, Tenn.
Bailey, Joseph W., I, '99 (D). Agent, Booth Manufacturing Company, New Bedford, Mass.
Bailey, Lester Harold, IV, '24 (B.T.C.). Textile Chemist, Tubize Artificial Silk Company, 2 Park Avenue, New York City.
Bailey, Walter James, IV, '11 (D). Bailey's Cleansers and Dyers, Watertown, Mass.
Baker, Franz Evron, VI, '26 (B.T.E.). Instructor, Cotton Yarn Department, Lowell Textile Institute, Lowell, Mass.
Baker, Maurice Sidney, IV, '25 (B.T.C.). Merchant, Fine's, Attleboro, Mass.
Baker, William John, IV, '16 (D). Supervisor, Du Pont Rayon Company, Old Hickory, Tenn.
Baker, William Samuel, I, '26 (D). Assistant Systemizer, Nashua Manufacturing Company, Nashua, N. H.
Balch, Ralph Herman, VI, '29 (B.T.E.). Research Department, Pacific Mills, Lawrence, Mass.
Baldwin, Arthur Lincoln, IV, '00 (D). Died December 1, 1919.

Baldwin, Frederick Albert, II, '04 (D). Vice-President and Secretary, Walter Blue & Co., Ltd., Sherbrooke, Que.

Ballard, Horace W. C. S., IV, '08 (D). Died September 28, 1918.

Barlofsky, Archie, VI, '17 (B.T.E.). Merchant, Economy Cash Market, 165 Chelmsford Street, Lowell, Mass.

Barr, I. Walwin, I, '00 (D). Second Vice-President, Buckley Brothers Company, 881 Broadway, New York City.

Barrett, Andrew Edward, IV, '23 (B.T.C.). Field Engineer, Armour & Co. (Industrial Soap Division), Babbitt, N. J.

Barry, Leo Joseph, II, '27 (D). With the Bell Company, Worcester, Mass.

Barsky, Morris Arnold, IV, '30 (B.T.C.). Chemist and Assistant Dyer, Pohatcong Hosiery Mills, Washington, N. J.

Bauer, Harold Conrad, III, '28 (D). Assistant Designer, Merrimac Mills, Methuen, Mass.

Beck, Frederic Christian, II, '24 (D). In business, Weld & Beck, Southbridge, Mass.

Beeman, Earl, VI, '30 (B.T.E.). 43 Botolph Street, Quincy, Mass.

Bell, Edward Benjamin, IV, '24 (B. T. C.). With Wallerstein Textiles, 270 Fourth Avenue, New York City.

Bennett, E. Howard, II, '03 (C). Publisher, American Wool and Cotton Reporter, 530 Atlantic Avenue, Boston, Mass.

Bennett, Herbert Bowen, II, '13 (D). Died January 23, 1920.

Bentley, Byron, II, '26 (D). With Joseph Bentley Hair Company, Methuen, Mass.

Bergeron, Alvin Wilfred, IV, '29 (B.T.C.). Textile Chemist, Celanese Corporation of America, Amcelle, Md.

Berry, Wilbur French, II, '17 (D). 23 Luzon Street, Providence, R. I.

Bienstock, George Jerrard, III, '24 (D). Research Director and Woolen Styler, The Bloch Company, Cleveland, Ohio.

Bigelow, Prescott Fenno, II, '12 (D). Died October 14, 1918.

Billings, Borden Dickinson, I, '29 (D). Superintendent, Thorndike Company, West Warren, Mass.

Bird, Clarence Henry, II, '22 (D). Superintendent, George E. Duffy Manufacturing Co., Worcester, Mass.

Bird, Francis John, VI, '22 (B.T.E.). With Potter's Fine Spinners, Pawtucket, R. I.

Blaikie, Howard Mills, II, '11 (D). 17 Maywood Avenue, Maywood, N. J.

Blake, Parker Gould, VI, '14 (D). District Manager, Claude Denis & Co., Ltd., Toronto, Ont.

Blanchard, John Lawrence, II, '23 (D). Designer, Farnsworth Company, Lisbon Centre, Me.

Bloom, Wilfred Nathaniel, IV, '03 (D). Died August 17, 1918.

Bodwell, Henry Albert, II, '00 (D). With Ludlow Manufacturing Associates, 80 Federal Street, Boston, Mass.

Booth, James Mooney, IV, '24 (B.T.C.). Salesman, The Huron Milling Company, Inc., 9 Park Place, New York City.

Bottomley, John, III, '28 (D). Assistant Designer, Amoskeag Manufacturing Company, Manchester, N. H.

Boyd, George Andrew, I, '05 (D). West Boylston, Mass.

Boylston, Theodore Willmott, IV, '21 (B.T.C.). Died June 3, 1921.

Brackett, Martin Richard, II, '22 (D). With Mackay, Sigler & Taylor, 215 Fourth Avenue, New York City.

Bradford, Harold Palmer, II, '25 (D). 90 Beach Street, Malden, Mass.

Bradford, Roy Hosmer, II, '06 (D). Textile Machinery, 161 Devonshire Street, Boston, Mass.

Bradley, Raymond Frost, VI, '14 (D). Garage Proprietor, Twin Light Garage, 267 East Main Street, Gloucester, Mass.

Bradley, Richard Henry, V, '01 (C). Gasoline Salesman, Fairhaven, Mass.

Brainerd, Arthur Travena, IV, '09 (D). Manager, Ciba Company, 325 West Huron Street, Chicago, Ill.

Brainerd, Carl Emil, IV, '20 (B.T.C.). Overseer of Dyeing, F. C. Huyck & Sons, Albany, N. Y.

Brainerd, Carroll Lewis, IV, '19 (B.T.C.). Died May 28, 1928.

Brandt, Carl Dewey, VI, '20 (B.T.E.). Head of Textile Department, Texas Technological College, Lubbock, Texas.

Brannen, Leon Vincent, III, '07 (C).

Brickett, Chauncy Jackson, II, '00 (D). Director, School of Textiles, International Correspondence School, Scranton, Pa.

Brickett, Raymond Calvin, II, '14 (D). Overseer, M. T. Stevens & Sons Company (Marland Mills), Andover, Mass.

Brigham, Howard Mason, VI, '24 (B.T.E.). Salesman, Wellington, Sears & Co., 65 Worth Street, New York City.

Bronson, Howard Seymour, II, '27 (D). Overseer of Knitting, Portage Hosiery Company, Portage, Wis.

Brosnan, William Francis, IV, '27 (B.T.C.). Vice-President and General Manager, Antipyros Company, 551 West 52d Street, New York City.

Brown, Gerald Marston, VI, '22 (B.T.E.). Supervisor of Training, Cheney Brothers, South Manchester, Conn.

Brown, Philip Franklin, II, '23 (D). District Sales Manager, DuPont Rayon Company, 2 Park Avenue, New York City.

Brown, Rollins Goldthwaite, IV, '12 (D). Sales Representative, White Brothers, Inc., Winchendon Springs, Mass.

Brown, Russell Lee, VI, '21 (B.T.E.). Assistant Professor, Lowell Textile Institute, Lowell, Mass.

Brown, Will George, Jr., IV, '22 (B.T.C.). Chemist, American Hide & Leather Company, Lowell, Mass.

Buchan, Donald Cameron, II, '01, (D). Assistant Superintendent, M. T. Stevens & Sons Company, North Andover, Mass.

Buchan, Norman Spaulding, IV, '26 (B.T.C.). Overseer of Dyeing, Pitman Manufacturing Company, Laconia, N. H.

Burbeck, Dorothy Maria, IV, '20 (B.T.C.). See Garlick, Mrs. Dorothy M.

Burger, Samuel Joseph, III, '24 (D). President, Heat Maintenance Service, Inc., Brooklyn, N. Y.

Burnham, Frank Erwin, IV, '02 (D). Dyestuff Chemist, Pacific Mills, Worsted Division, Lawrence, Mass.

Burns, Robert, IV, '28 (B.T.C.). Chemist, Celanese Corporation of America, Amcelle, Md.

Burrage, Katherine C., IIIb, '99 (C). Died May 16, 1914.

Buzzell, Harry Saville, VI, '29 (B.T.E.). Supervisor of Raw Materials Testing Laboratory, Oxford Paper Company, Rumford, Me.

Callahan, John Joseph, Jr., II, '26 (D). Color Chemist, A. Klipstein & Co., 263 Summer Street, Boston, Mass.

Cameron, Elliott Francis, IV, 'II (D). Attorney-at-law, Willard, Allen and Mulhern, 100 Milk Street, Boston, Mass.

Campbell, Alexander, VI, '23 (B.T.E.). Resident Engineer, Charles T. Main, Inc., Engineers, 201 Devonshire Street, Boston, Mass.

Campbell, Laura Etta, IIIb, '00 (C). Deceased.

Campbell, Louise Porter, IIIb, '03 (C). With Ginn & Co., 15 Ashburton Place, Boston, Mass.

Campbell, Orison Sargent, II, '03 (D). Manager Felt Department, Canadian Consolidated Felt Company, Ltd., Kitchener, Ont.

Cannell, Philip Stuart, VI, '23 (B.T.E.) Industrial Engineer, Brown & Sharpe Manufacturing Co., Providence, R. I.

Carleton, Joseph Raddin, III, '30 (D). Designer with Katrine Hooper, 6 Newbury Street, Boston, Mass.

Carr, George Everett, I, '05 (D). Industrial Engineer, C. F. Mueller Company, 180 Baldwin Avenue, Jersy City, N. J.

Carr, Paul Edward, II, '24 (D) Designer, Pondicherry Woolen Company, Bridgton, Me.

Carter, Robert Albion, IV, '02 (D). Dyestuff Salesman, E. I. du Pont de Nemours & Co., 128 South Front Street, Philadelphia, Pa.

Carter, Russell Albert, II, '25 (D). With Thermo Mills, Inc., West Sand Lake, N. Y.

Cary, Julian Clinton, VI, '10 (D). Branch Manager, The American Mutual Liability Insurance Company, 226 Pearl Street, Hartford, Conn.

Caya, Ferdinand Joseph, IV, '22 (B.T.C.). Superintendent of Dyeing, Gotham Silk Hosiery Company, Inc., Wharton, N. J.

Chamberlin, Frederick Ellery, I, '03 (D). Overseer of Spinning, Monument Mills, Housatonic, Mass.

Chandler, Proctor, IV, '11 (D). Manager, Chandler Manufacturing Company, 56 Amherst Street, Cambridge, Mass.

Chang, Chi, VI, '23 (B.T.E.).

Chang, Wen Chuan, VI, '21 (B.T.E.). Dah Sung Cotton Mill No. 1, Nantung, Kiangsu, China.

Chapman, Leland Hildreth, VI, '24 (B.T.E.). Vice-Principal, Hingham High School, Hingham, Mass.

Chen, Shih Ching, IV, '22 (B.T.C.). Hou Sung Cotton Mill, Shanghai, China.

Chen, Wen-Pei, IV, '24 (B.T.C.).

Chisholm, Lester Bury, I, '11 (D). General Plant Manager, American Mills Company, Waterbury, Conn.

Church, Charles Royal, II, '06 (C).

Churchill, Charles Whittier, III, '06 (D). Manager, Churchill Manufacturing Company, Inc., Lowell, Mass.

Clapp, F. Austin, II, '04 (D). General Agent, Lloyds Casualty Company, Springfield, Mass.

Clark, Earl William, IV, '18 (B.T.C.). Chemist, Cheney Brothers, South Manchester, Conn.

Clark, Thomas Talbot, II, '10 (D). President and Treasurer, Talbot Mills, North Billerica, Mass.

Clarke, George Dean, II, '21 (C). Dyer, Seamans & Cobb Thread Mills, Hopkinton, Mass.

Clayton, Harold Edmund, VI, '21 (B.T.E.). Manager, Brown Hosiery Company, Lowell, Mass.

Cleary, Charles Joseph, II, '13 (D). Textile Technologist, United States Army Air Service, Wright Field, Dayton, Ohio.

Clement, David Scott, IV, '24 (B.T.C.). Chemist, Nashua Manufacturing Company, Nashua, N. H.

Cleveland, Richard Sumner, VI, '30 (B.T.E.). Junior Textile Technologist, National Bureau of Standards, Department of Commerce, Washington, D. C.

Clifford, Albert Chester, VI, '22 (B.T.E.). Textile Engineer, Western Electric Company, Inc., Kearny, N. J.

Clogston, Raymond B., IV, '04 (D). Superintendent of Dyeing, Merrimack Manufacturing Company, Lowell, Mass.

Cluett, John Girvin, I, '29 (D). Textile Analyst and Assistant to Superintendent, Cluett, Peabody & Co., Inc., Peebles Island, Waterford, N. J.

Coan, Charles Bisbee, IV, '12 (D.)

Coffey, Daniel Joseph, III, '28 (D). Assistant Superintendent and Finisher, Thermo Mills, Inc., Hudson, N. Y.

Cohen, Arthur Edward, IV, '23 (B.T.C.)

Cohen, Raphael Edvab, IV, '25 (B.T.C.) Secretary and Sales Manager, Merrimack Paper Tube Company, Inc., Lowell, Mass.

Colby, J. Tracy, VI, '16 (D). Salesman, F. C. Huyck & Sons, 268 Fourth Avenue, New York City.

Colby, Willard Alvah, Jr., IV, '30 (B.T.C.). Chemist, Utica Willowvale Bleachery, Chadwicks, N. Y.

Cole, Edward Earle, IV, '06 (D). Financial Agent, The Bradstreet Company, Boston, Mass.

Cole, James Thomas, II, '05 (D). Treasurer, Arlington Industries for the Blind, Arlington, Mass.

Finishing Department

Collonan, Herbert Joseph, II, '22 (D). Moosup, Conn.

Coman, James Groesbeck, I, '07 (D). Superintendent, Mexia Textile Mills, Mexia, Texas.

Conant, Harold Wright, I, '09 (D). Assistant Treasurer, United Elastic Corporation, Easthampton, Mass.

Conant, Richard, Goldsmith, I, '12 (D). Sales Executive, Wellington, Sears & Co., 65 Worth Street, New York City.

Conklin, Jennie Grace, IIIb, '05 (C). See Nostrand, Mrs. William L.

Connor, Thomas Francis, II, '28 (D). 41 Elmore Street, Roxbury, Mass.

Connorton, John Joseph, Jr., III, '27 (D). Head Designer, Amoskeag Manufacturing Company, Manchester, N. H.

Cook, Kenneth Bartlett, I, '13 (D). Technical Manager, Manville-Jenckes Company, Pawtucket, R. I.

Corbett, James Francis, IV, '28 (B.T.C.). Chemist, in charge of Print Laboratory, Pacific Mills, Lawrence, Mass.

Cosendai, Edwin Frederick Ernest, IV, '15 (B.T.D.). Died November 1, 1923.

Cote, Theodore Charles, IV, '26 (B.T.C.). Chemist, Merrimack Manufacturing Company, Lowell, Mass.

Craig, Albert Wood, IV, '07 (D). Superintendent, Windsor Print Works, North Adams, Mass.

Craig, Clarence Eugene, III, '02 (D).

Creese, Guy Talbot, IV, '14 (D). Chemist, Creese & Cook Company, Danversport, Mass.

Crowe, Joseph Bailey, IV, '25 (B.T.C.). Chemical Engineer, Textile Division, Procter & Gamble Co., Cincinnati, Ohio.

Culver, Ralph Farnsworth, IV, '04 (D). Vice-President and Manager, Providence Office, Ciba Company, Inc., 61 Peck Street, Providence, R. I.

Cummings, Edward Stanton, VI, '16 (D). Industrial Engineer, with R. E. Loper & Co., Greenville, S. C.

Curran, Charles Ernest, III, '02 (C). Head Designer, Wood Worsted Mills, Lawrence, Mass.

Currier, Herbert Augustus, I, '06 (D). Vice-President, Waterman, Currier & Co., Inc., Cotton Yarn Merchants, 40 Worth Street, New York City.

Currier, John Alva, II, '01 (D). Superintendent, Pentucket Mills (M. T. Stevens & Sons Company), Haverhill, Mass.

Curtis, Frank Mitchell, I, '06 (D). Retail Lumber, Wm. Curtis Sons Company, 10 Blue Hill Avenue, Milton, Mass.

Curtis, William Leavitt, II, '05 (C.)

Cutler, Benjamin Winthrop, Jr., III, '04 (D). Department Manager, Worth Textile Company, 40 Worth Street, New York City.

Cuttle, James H., II, '99 (D). Superintendent, S. Stroock & Co., Inc., Newburgh, N. Y.

Dalton, Gregory Smith, IV, '12 (D).

Darby, Avard Nelson, II, '28 (D). General Foreman, Plant No. 2, Merrimac Hat Corporation, Amesbury, Mass.

Datar, Anant Vithal, VI, '24 (B.T.E.). Secretary and Manager, The Pulgaon Cotton Manufacturing Company, Ltd., Pulgaon, C. P., India.

Davidson, Sydney, III, '28 (D). 64 Devon Street, Roxbury, Mass.

Davieau, Alfred Edward, VI, '16 (D). Textile Engineer, in charge of Textile Testing, United States Testing Company, Inc., 316 Hudson Street, New York City.

Davieau, Arthur Napoleon, VI, '13 (D). Superintendent, Kenwood Mills, Ltd., (F. C. Huyck & Sons), Arnprior, Ont.

Davieau, Leon Arthur, VI, '23 (B.T.E.). With United States Rubber Company (Textile Section), 451 South Jefferson Street, Orange, N. J.

Davis, Alexander Duncan, VI, '14 (B.T.E.). Instructor, Northeastern University, Springfield, Mass.

Dearborn, Roy S., VI, '13 (D). Salesman, Dumas & Co., Lowell, Mass.

Dearth, Elmer Elbridge, IV, '12 (D). General Plant Manager, The Fisk Rubber Company, Chicopee Falls, Mass.

Del Plaine, Parker Haywood, IV, '25 (B.T.C.) Textile Chemist, Rohm & Haas Company, Bristol, Pa.

Derby, Roland Everett, IV, '22 (B.T.C.). Chemist, M. T. Stevens & Sons Company, North Andover, Mass.

de Sa, Francisco, VI, '18 (B.T.E.). Avenue da Graca, Bahia, Brazil.

Dewey, James French, II, '04 (D). Woolen Manufacturer, A. G. Dewey Company, Quechee, Vt.

Dewey, Maurice William, II, '11 (D). Montpelier, Vt.

Dillon, James Henry, III, '05 (D).

Dods, James Barber, II, '27 (D). Vice-President and General Manager, The Dods Knitting Company, Ltd., Orangeville, Ont.

Dolan, William Francis, IV, '28 (B.T.C.). Dyer, Lowell Bleachery South, Griffin, Ga.

Donald, Albert Edward, II, '04 (D). Agent, H. T. Hayward Company, Franklin, Mass.

Donovan, Joseph Richard, IV, '24 (B.T.C.). Proprietor, Scientific Laundry, 484 Main Street, Charlestown, Mass.

Doran, Wilbur Kirkland, II, '22 (D). Manchester, N. H.

Dorr, Clinton Lamont, VI, '14 (D). Merchant, Raymond's, Inc., 356 Washington Street, Boston, Mass.

Douglas, Walter Shelton, II, '21 (D). Estimator, Douglas & Co., Lowell, Mass.

Duguid, Harry Wyatt, I, '24 (D). Assistant Superintendent, Maverick Mills, East Boston, Mass.

Dunlap, Kirke Harold, Jr., VI, '30 (B.T.E.). 58 Hanks Street, Lowell, Mass.

Dunnican, Edward Tunis, VI, '24 (B.T.E.). With Pacific Mills, 24 Thomas Street, New York City.

Durgin, William Ernest, IV, '24 (B.T.C.). With Geigy Company, Inc., 88 Broad Street, Boston, Mass.

Duval, Joseph Edward, II, '10 (D). Yarn Agent, 308 Chestnut Street, Philadelphia, Pa.

Dwight, John Francis, Jr., II, '08 (D). Proprietor, Humarock Inn, Humarock, Mass.

Echmalian, John Gregory, VI, '16 (B.T.E.). Director, State Trade School, South Manchester, Conn.

Ehrenfried, Jacob Benjamin, II, '07 (C). Manager, George Ehrenfried Company, Lewiston, Maine.

Elliott, Gordon Baylies, II, '12 (D). Planning Department, Pacific Mills, Lawrence, Mass.

Ellis, Charles Albert, VI, '21 (B.T.E.). Engineer, City of Syracuse, Syracuse, N. Y.

Ellis, Dorothy Myrta, VI, '25 (B.T.E.). Junior Cotton Technologist, Department of Agriculture, Washington, D. C.

Ellis, James Oliver, VI, '29 (B.T.E.). With Cheney Brothers, South Manchester, Conn.

Emerson, Frank Warren, II, '03 (D). 130 Butman Road, Lowell, Mass.

Engstrom, Karl Emil, VI, '12 (D). (**S.B. 1916, Massachusetts Institute of Technology.**) With Lockwood, Greene & Co., Boston, Mass.

Enloe, Winfred Paige, I, '22 (D). Assistant Superintendent, The W. A. Handley Manufacturing Company, Roanoke, Ala.

Evans, Alfred Whitney, III, '03 (D).

Evans, Paul Richard, II, '29 (D). With United States Testing Company, New York City.

Evans, William Robinson, III, '03 (D). 309 Main Street, Bradford, Mass.

Everett, Charles Arthur, IV, '19 (B.T.C.). Instructor, Dyeing Department, Lowell Textile Institute, Lowell, Mass.

Ewer, Nathaniel Trull, IV, '01 (D).

Fairbanks, Almonte Harrison, II, '09 (D). Treasurer and Manager, Middlesex Knitting Company, Wakefield, Mass.

Farley, Clifford Albert, VI, '28 (B.T.E.). Office Manager and Purchasing Agent, Thorndike Company, West Warren, Mass.

Farmer, Chester Jefferson, IV, '07 (D). (Ph.D. Harvard University.) Professor of Chemistry, Northwestern University Medical School, Chicago, Ill.

Farnsworth, Harold Vincent, VI, '16 (B.T.E.). Textile Engineer, Atkinson, Haserick & Co., 152 Congress Street, Boston, Mass.

Farr, Leonard Schaefar, II, '08 (D). Assistant Superintendent, No. 2 Mill, Farr Alpaca Company, Holyoke, Mass.

Farwell, Claude Chapman, VI, '23 (B.T.E.). Instructor, Mathematics and Physics, Story High School, Manchester, Mass.

Farwell, Ray Baldwin, VI, '24 (B.T.E.) Died July 6, 1926.

Fasig, Paul Leon, IV, '28 (B.T.C.). Industrial Fellow, Mellon Institute of Industrial Research, Pittsburgh, Pa.

Feinberg, Benjamin, II, '27 (D). General Manager, Bradford Hat Company, Haverhill, Mass.

Feindel, George Paul, IV, '24 (B.T.C.). Chemist, Union Bleachery, Greenville, S. C.

Feldstein, Martin Alexander, VI, '24 (B.T.E.) Radio Engineer, General Electric Company, Hotel Majestic, Lakewood, N. J.

Fels, August Benedict, II ,'99 (D).

Ferguson, Arthur Feiling, I, '03 (D). With United States Tariff Commission, Washington, D. C.

Ferguson, William Gladstone, III, '09 (D). Assistant Agent, Ludlow Manufacturing Associates, Ludlow, Mass.

Ferris, Arthur Leon, II, '28 (D).. Port Rowan, Ont.

Finlay, Harry Francis, IV, '10 (D). Chemist and Demonstrator, National Aniline and Chemical Company, Boston, Mass.

Fisher, Russell Todd, VI, '14 (D). '25 (B.T.E.). Secretary, National Association of Cotton Manufacturers, 80 Federal Street, Boston, Mass.

Fiske, Starr Hollinger, II, '09 (D). Owner and Manager, Wing's Cash Market, Lowell, Mass.

Fitzgerald, John Francis, IV, '18 (B.T.C.). Dyer, Boston Dye House, Inc., Malden, Mass.

Fitzgerald, John Francis, IV, '28 (B.T.C.). Chemist, Southbridge Finishing Company, Southbridge, Mass.

Fleischmann, Meyer, IV, '20 (B.T.C.). Chief Chemist, Real Silk Hosiery Mills, Indianapolis, Ind.

Fleming, Frank Everett, IV, '06 (D). Overseer, Dyeing and Finishing, Goodall Worsted Company, Sanford, Maine.

Fletcher, Howard Varnum, III, '25 (D). Salesman, Sun Oil Company, Poughkeepsie, N. Y.

Fletcher, Roland Hartwell, VI, '10 (D). With Pressed Steel Car Company, Pittsburgh, Pa.

Flood, Thomas Henry, IV, '27 (B.T.C.). Sales Department, National Aniline & Chemical Company, 40 Rector Street, New York City.

Flynn, Thomas Patrick, IV, '11 (D). Sales Manager, E. L. Thompson Chair Corporation, Baldwinsville, Mass.

Ford, Edgar Robinson, IV, '11 (D). Technical Superintendent, Sayles Biltmore Bleacheries, Biltmore, N. C.

Ford, Stephen Kenneth, IV, '28 (B.T.C.). Chemist, Cheney Brothers, South Manchester, Conn.

Forsaith, Charles Henry, VI, '20 (B.T.E.). Superintendent, Nashua Manufacturing Company (Jackson Mills), Nashua, N. H.

Forsaith, Ralph Allen, VI, '16 (B.T.E.). With Anderson-Meyer Company, Ltd., Shanghai, China.

Forsyth, Harold Downes, VI, '23 (B.T.E.). Treasurer, Wm. Forsyth & Sons Company, Lynn, Mass.

Foster, Boutwell Hyde, VI, '17 (B.T.E.). Manager, Textile Section, United States Rubber Company, 451 South Jefferson Street, Orange, N. J.
Foster, Clifford Eastman, II, '01 (D). 35 Mount Vernon Street, New Bedford, Mass.
Fowle, Edwin Daniels, VI, '24 (B.T.E.). Associate Editor, "Textile World," 10th Avenue at 36th Street, New York City.
Franks, Jerome, VI, '27 (B.T.E.). (M.S. 1929, Massachusetts Institute of Technology.) 44 Midwood Street, Brooklyn, N. Y.
Fredrickson, Charles Joseph, Jr., IV, '29 (B.T.C.). Technical Research, National Leather Company, Peabody, Mass.
Frost, Harold Benjamin, II, '12 (D). Salesman, Liberty Mutual Insurance Company, Boston, Mass.
Fuller, Allen Reed, IV, '17 (B.T.C.). Textile Chemist, Federal Phosphorus Company, Anniston, Ala.
Fuller, George, I, '03, (D). Consulting Textile Specialist, Cox, Fuller and Mauersberger, 320 Broadway, New York City.

Gadsby, Arthur Norton, II, '13 (D). Deceased.
Gahm, George Leonhard, II, '06 (D). Superintendent, Yarn Department, Wood Worsted Mills, Lawrence, Mass.
Gainey, Francis William, IV, '11 (D). Assistant Superintendent, Cheney Brothers, South Manchester, Conn.
Gale, Harry Laburton, III, '10 (D). Sales Manager, Colored Goods Department, Iselin-Jefferson Company, 328 Broadway, New York City.
Gallagher, Arthur Francis, IV, '30 (B.T.C.). With Hillsborough Mills, Wilton, N.H.
Gallagher, John Waters, II, '27 (D). With E. I. du Pont de Nemours & Co., Fairfield, Conn.
Garlick, Mrs. Dorothy M. (Burbeck, Dorothy M.), IV, '20 (B.T.C.). 192 Great Road, Maynard, Mass.
Garner, Allen Frank, II, '30 (D). Assistant Superintendent, Kezar Falls Woolen Company, Kezar Falls, Me.
Gaudet, Walter Urban, II, '29 (D). Mill Department, Wellington, Sears & Co., 65 Worth Street, New York City.
Gay, Olin Dow, II, '08 (D). Woolen Manufacturer, Gay Brothers Company, Cavendish, Vt.
Gerrish, Henry Kilborn, III, '16 (D). Died September 18, 1922.
Gerrish, Walter, III, '03 (D).
Gillie, Stanley James, I, '22 (D). Assistant Manager, United States Testing Company, Inc., 207 Chestnut Street, Philadelphia, Pa.
Gillon, Sara Agnes, IIIb, '06 (C).
Gilman, Ernest Dana, II, '26 (D). Assistant Designer, with Pacific Mills, Lawrence, Mass.
Glickman, Bernhardt Brecher, IV, '27 (B.T.C.). Student, Columbia University, New York City.
Godfrey, Harold Thomas, VI, '26 (B.T.E.). Textile Field Engineer, Davis & Furber Machine Co., North Andover, Mass.
Goldberg, George VI, '10 (D). Salesman, Liberty Lace and Braid Company, 88 Bedford St., Boston, Mass.
Goldenberg, Louis G., VI, '27 (B.T.E.). Foreman of Knitting, Raynit Mills, Brooklyn, N. Y.
Goldman, Moses Hyman, IV, '20 (B.T.C.). Textile Chemist, Eagle Dye Works, 396 Woodland Street, Hartford, Conn.
Goller, Harold Poehlmann, II, '23 (D). 22 Wallace Street, Freeport, L. I., N.Y.
Goodhue, Amy Helen, IIIb, '00 (C). See Harrison, Mrs. Arthur.
Gooding, Francis Earle, IV, '19 (B.T.C.). General Foreman, Calco Chemical Company, Bound Brook, N. J.
Goosetrey, Arthur, IV, '21 (B.T.C.). New York Mills, N. Y.
Goosetrey, John Thomas, IV, '21 (B.T.C.). Assistant Dyer, New York Mills Corporation, New York Mills, N. Y.

Experimental Dyeing Laboratory

Gottschalck, Lawrence William, VI, '28 (B.T.E.). With Scott & Williams, Inc., 366 Broadway, New York City.

Gould, Norman Culver, VI, '19 (B.T.E.). Designer, F. C. Huyck & Sons, Renssalaer, N. Y.

Greenbaum, Herbert Baron, III, '29 (D). Salesman, American Woolen Company, 225 Fourth Avenue, New York City.

Greenberg, Archie, II, '21 (D). Treasurer, M. H. Corash Company, Inc. Worcester, Mass.

Greendonner, George John, Jr., IV, '30 (B.T.C.). With National Aniline & Chemical Co., Inc., Buffalo, N. Y.

Greenwood, John Roger, Jr., II, '27 (D). Assistant Superintendent, D. N. Taft Manufacturing Company, Oxford, Mass.

Gross, Herman Peter, IV, '30 (B.T.C.). 94 Shanley Avenue, Newark, N. J.

Guild, Lawrence Winfield, VI, '27 (B.T.E.). Salesman, Du Pont Rayon Company, 941 Hospital Trust Building, Providence, R. I.

Gwinnell, George Harry, II, '25 (D). Designer, Berkshire Woolen Company, Pittsfield, Mass.

Gyzander, Arne Kolthoff, IV, '09 (D). With National Aniline and Chemical Co., 40 Rector Street, New York City.

Haddad, Nassib, VI, '23 (B.T.E.). Textile Engineer, United States Rubber Company, Orange, N. J.

Hadley, Richard Francis, IV, '22 (B.T.C.). Vice-President, Carbon Coal & Coke Company, 80 Federal Street, Boston, Mass.

Hadley, Walter Eastman, IV, '08 (D). Consulting Textile Chemist, Maplewood, N. J.

Hadley, Wilfred Nourse, II, '22 (D). Salesman, Parks & Woolson Machine Company, Springfield, Vt.

Hager, Hazen Otis, II, '21 (C). Treasurer and Manager, Suburban Gas and Equipment Company, Portland, Maine.

Hall, Frederick Kilby, VI, '24 (B.T.E.). (A. M. 1930, The George Washington University.) Assistant Business Specialist, Marketing Service Division, United States Department of Commerce, Washington, D. C.

Halsell, Elam Ryan, I, '04 (C). Assistant Superintendent, Whittenton Manufacturing Company, Taunton, Mass.

Hammond, Chester Twombly, II, '23 (D). Wool Department, Mohawk Carpet Mills, Inc., Amsterdam, N. Y.

Hanscom, Edwin Thomas, II, '27 (D). Assistant Superintendent, Hartford Woolen Mills, Hartford, Vt.

Hardie, Newton Gary, I, '23 (D). Superintendent, Oconee Mills Company, Westminster, S. C.

Hardy, Philip Lewis, VI, '10 (D). Contractor, Andover, Mass.

Harmon, Charles Francis, I, '99 (D).

Harrington, Thomas, IV, '15 (D). Superintendent, Monarch Leather Company, 1127 West Division Street, Chicago, Ill.

Harris, Charles Edward, I, '05 (D). Manager, Martin Fifth Wheel and Trailer Corporation, Easthampton, Mass.

Harris, George Simmons, I, '02 (C). Associate, Hunter Manufacturing & Commission Company of New York; President, Lowe Manufacturing Company (Huntsville, Ala.), and Treasurer, Shelbyville Mills (Shellbyville, Tenn.), Glenn Building, Atlanta, Ga.

Harrison, Mrs. Arthur (Goodhue, Amy Helen), IIIb, '00 (C). R. F. D. No. 2, Lowell, Mass.

Hart, Arthur Norman, IV, '19 (B.T.C.).

Hart, Howard Roscoe, I, '23 (D). Superintendent, Victory Manufacturing Company, Fayetteville, N. C.

Haskell, Spencer Howard, II, '07 (D). Deceased.

Haskell, Walter Frank, IV, '02 (D). Overseer of Dyeing, Dana Warp Mills, Westbrook, Maine.

Hassett, Paul Joseph, IV, '12 (D). Production Manager, Cortland Works, L. C. Smith & Corona Typewriters, Inc., Syracuse, N. Y.

Hathaway, William Tabor, II, '26 (D). 9 Tenney Street, North Cambridge, Mass.

Hathorn, George Wilmer, IV, '07 (D). Chemist, Lawrence Gas Company, Lawrence, Mass.

Hathorne, Berkeley Lewis, IV, '24 (B.T.C.). Chemist, Tubize Chatillon Corporation, 114 East 32nd Street, New York City.

Hay, Ernest Crawford, II, '11 (D). Superintendent, Monomac Spinning Company, Lawrence, Mass.

Haynes, Amos Kempton, IV, '29 (B.T.C.). Textile Research Chemist, Rohm & Haas Co., Bristol, Pa.

Hendrickson, Walter Alexander, II, '11 (D). With National Knitting Company, 905 Clinton Street, Milwaukee, Wis.

Hennigan, Arthur Joseph, II, '06 (D). With Cox & Schreiber, 225 Fourth Avenue, New York City.

Hetherman, Patrick Joseph, IV, '29 (B.T.C.). Chemist, Bradley Building, Lowell, Mass.

Hibbard, Frederick William, IV, '25 (B.T.C.). Investment Broker, Andrews & Hibbard, 701 Bay State Building, Lawrence, Mass.

Hildreth, Harold William, II, '07 (D). Draftsman, C. G. Sargent's Sons Corporation, Graniteville, Mass.

Hillman, Ralph Greeley, VI, '22 (B.T.E.). Assistant Superintendent,S amson Cordage Works, Shirley, Mass.

Hindle, Milton, VI, '25 (B.T.E.). Instructor, Lowell Textile Institute, Lowell, Mass.

Hintze, Thomas Forsyth, I, '06 (C). President, Seaboard Gas and Fuel Co., 250 Stuart Street, Boston, Mass.

Hodge, Harold Bradley, VI, '22 (B.T.E). Auxiliary Division, Cheney Brothers, South Manchester, Conn.

Hoffman, Richard Robert, II, '21 (C).

Holbrook, Ralph Wentworth, IV, '29 (B.T.C.). Textile Chemist and Colorist, General Dyestuff Corporation, 230 Fifth Avenue, New York City.

Holden, Francis Crawford, IV, '09 (D). Chemist, Chelsea Fibre Mills, 1155 Manhattan Avenue, Brooklyn, N. Y.

Holden, John Sanford, II, '20 (D). Manufacturer, Automatic Machine Products Company, Attleboro, Mass.

Holgate, Benjamin, III, '02 (C). Agent, Boott Mills, Lowell, Mass.

Hollings, James Louis, I, '05 (D). Buyer and Converter (Cotton Goods), W. R. Grace and Co., 7 Hanover Square, New York City.

Hollstein, William Diedrick, VI, '25 (B.T.E.). With General Silk Corporation, 501 Seventh Avenue. New York City.

Holmes, Otis Milton, VI, '13 (B.T.E.). Draftsman, United Shoe Machinery Corporation, Beverly, Mass.

Holt, Laurence Currier, VI, '29 (B.T.E.). Department Head in Charge of Winding, Celanese Corporation of America, Amcelle, Md.

Hood, Leslie Newton, IV, '12 (D). Bleachery Superintendent, Selma Manufacturing Company, Selma, Ala.

Hook, Russell Weeks, IV, '05 (D). Textile Chemist, Arthur D. Little, Inc., 30 Charles River Road, Cambridge, Mass.

Hooper, Clarence, IV, '27 (B.T.C.). Chemist, Sayles Finishing Plants, Inc., Saylesville, R. I.

Horne, James Albert, I, '24 (D). Sales Department, Wellington, Sears & Co., 65 Worth Street, New York City.

Horsfall, George Gordon, II, '04 (C). Assistant Dyer, Interwoven Mills, Inc., Martinsburg, W. Va.

Horton, Chester Temple, VI, '14 (B.T.E.). Wilmington, Mass.

Houghton, Robert Kingsbury, IV, '23 (B.T.C.). Textile Chemist, Cheney Brothers, South Manchester, Conn.

Howarth, Charles Lincoln, IV, '17 (B.T.C.). Assistant Professor of Dyeing, Lowell Textile Institute, Lowell, Mass.

Howorth, Harmon, VI, '30 (B.T.E.). Textile Development, Celanese Corporation of America, Amcelle, Md.

Howe, Woodbury Kendall, I, '10 (D). Assistant Superintendent, Merrimack Manufacturing Company, Lowell, Mass.

Hoyt, Charles William Henry, IV, '07 (D). 27 Lenox Avenue, White Plains, N. Y.

Hsu, Hsueh-Chang, VI, '23 (B.T.E.).

Hubbard, Harold Harper, I, '22 (D). 908 Beacon Street, Boston, Mass.

Hubbard, Ralph King, IV, '11 (D). President and Treasurer, Packard Mills, Inc., Webster, Mass.

Huising, Geronimo Huerva, I, '08 (D).

Hunt, Chester Lansing, III, '05 (C).

Hunton, John Horace, II, '11 (D). Superintendent, Wool Department, Nashua Manufacturing Company, Nashua, N. H.

Hurd, Ira Swain, IV, '29 (B.T.C.). Textile Colorist, General Dyestuff Corporation, 230 Fifth Avenue, New York City.

Hurtado, Leopoldo, Jr., VI, '10 (D). General Manager, Hurtado & Co., Uruapan Michoacan, Mex.

Hurwitz, Jacob, IV, '23 (B.T.C.).

Hutton, Clarence, III, '03 (C). Vice-President and Editor, "The Melliand," Woolworth Building, New York City.

Hyman, Wolfred, II, '28 (D). With Hyman Brothers, Boston, Mass.

Irvine, James Andrew, VI, '17 (B.T.E.). Manager of Employment and Training, Cheney Brothers, South Manchester, Conn.

Isaacson, George Franklin, II, '26 (D). With Clarence S. Brown & Co., 40 Worth Street, New York City.

Jaeger, Robert William, Jr., IV, '23 (B.T.C.). Lubrication Engineer, Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago, Ill.

Jelleme, William Oscar, I, '10 (D). With Pacific Mills, 24 Thomas Street, New York City.

Jen, Shang Wu, I, '21 (D).

Jenckes, Leland Aldrich, VI, '08 (D). Deceased.

Jessop, Charles Clifford, VI, '22 (B.T.E.). Textile Engineer, Campbell Peterson, Inc., 84 Williams Street, New York City.

Johnson, Arthur Kimball, IV, '13 (D). (**S.B. 1917, Massachusetts Institute of Technology.**) Research Chemist, Cheney Brothers, South Manchester, Conn.

Johnson, George Henry, IV, '20 (B.T.C.). Director of Research, Laundry Owners National Association, Joliet, Ill.

Johnson, Philip Stanley, IV, '24 (B.T.C.). 119 Brainerd Avenue, Allston, Mass.

Jones, Bliss Morris, IV, '30 (B.T.C.). Managing Editor, Howes Publishing Company, 440 Fourth Avenue, New York City.

Jones, Everett Amos, III, '05 (D). Superintendent, Nye & Wait Kilmarnock Corporation, Auburn, N. Y.

Jones, Nathaniel Erskine, I, '21 (D). Assistant Superintendent, E. L. Watkins, 604 Forest Avenue, Portland, Maine.

Joslin, Harold Wheeler, II, '28 (D). Second Hand, Finishing, Souhegan Woolen Company, Wilton, N. H.

Joy, Thomas, VI, '26 (B.T.E.). Lubrication Engineer, Vacuum Oil Company, 61 Broadway, New York City.

Jury, Alfred Elmer, IV, '04 (D). Agent, United States Rubber Company, (Winnsboro Mills,) Winnsboro, S. C.

Kaatze, Julius, VI, '22 (B.T.E.). Salesman, Toledo Scale Company, Lawrence, Mass.

Kao, Chieh-Ching, VI, '23 (B.T.E.).

Karanfilian, John Hagop, VI, '21 (B.T.E.).

Kay, Harry Pearson, II, '09 (D). Associate Member, Stanford Wright Agency, Penn Mutual Life Insurance Company, Boston, Mass.

Kendall, Charles Henry, II, '23 (D). Superintendent, Bridgewater Woolen Company, Bridgewater, Vt.
Kennedy, Francis Charles, VI, '26 (B.T.E.). Product Development Department, The Fisk Rubber Company, Chicopee Falls, Mass.
Kenney, Frederick Leo, II, '27 (D). Assistant Designer, Uxbridge Worsted Company, Uxbridge, Mass.
Kent, Clarence LeBarron, III, '06 (C). Sub-District Manager, Standard Oil Company, Portland, Maine.
Keough, Wesley Lincoln, II, '10 (D). With E. A. Pierce & Co., Pasadena, Calif.
Killheffer, John Vincent, IV, '28 (B.T.C.). Salesman, Newport Chemical Works, Inc., Greenville, N. C.
Kingsbury, Percey Fox, IV, '01 (D). With Passaic Print Works, 320 Broadway, New York City.
Knowland, Daniel Power, IV, '07 (D). Chief Chemist, Geigy Company, Inc., 89 Barclay Street, New York City.
Knox, Joseph Carleton, VI, '23 (B.T.E.). Sanitary Engineer, Massachusetts Department of Health, Boston, Mass.
Kolsky, Samuel Irving, IV, '30 (B.T.C.). Chemist, G. P. Wilman Company, Lawrence, Mass.
Konieczny, Henry, IV, '30 (B.T.C.). 1276 Bridge Street, Dracut, Mass.
Kostopoulos, Emanuel Arthur, VI, '30 (B.T.E.). 270 Adams Street, Lowell, Mass.
Krishan, Maharaj, VI, '30 (B.T.E.). Montgomery, India.
Kuo, Limao, VI, '26 (B.T.E.). In charge of Quality Testing Division, Shanghai Bureau of Inspection and Testing of Commercial Commodities, Shanghai, China.

Lakeman, Fannie Shillaber, IIIb, '00 (C). Died February 8, 1921.
Lamb, Arthur Franklin, II, '10 (D). In business, Cleansing and Dyeing, Rockland, Maine.
Lamont, Robert Laurence, II, '12 (D).
Lamprey, Leslie Balch, IV, '16 (B.T.D.). 18 Holton Street, Lawrence, Mass.
Lamson, George Francis, I, '00 (D). With Ludlow Manufacturing Associates, Ludlow, Mass.
Lane, John William, I, '06 (C).
Lane, Oliver Fellows, IV, '15 (B.T.D.). Chemist, Head of Color Making Department, Lowe Paper Company, Ridgefield, N. J.
Larratt, John Francis, II, '22 (D). 235 Princeton Boulevard, Lowell, Mass.
Laughlin, James Knowlton, III, '09 (D).
Laurin, Eric Thursten Lawrence, IV, '21 (B.T.C.). Chemist and Colorist, Sayles Finishing Plant, Saylesville, R. I.
Laurin, Sven Albert, IV, '23 (B.T.C.). Student, Boston University, Boston, Mass.
Leach, John Pelopidas, I, '00 (C). Farming, Mosby Hall Farm, Littleton, N. C.
Leavitt, George Herbert, II, '26 (D). Inspector, F. C. Huyck & Sons, Albany, N. Y.
Lee, William Henry, II, '05 (C). Manager, Graves Hall & Co., Inc., New Haven, Conn.
Leitch, Harold Watson, IV, '14 (B.T.D.). Superintendent, Dyeing and Finishing, Pacific Mills, Lawrence, Mass.
Lemire, Joseph Emile, VI, '21 (B.T.E.). Mathematics Instructor, Lowell High School, Lowell, Mass.
Leonard, Leo Edward, I, '27 (D). Designer, Worcester Textile Company, Valley Falls, R. I.
Levi, Alfred Sandel, IV, '09 (D). Vice-President, Liondale Bleach, Dye and Print Works, Rockaway, N. J.
Lewis, George Kenneth, VI, '24 (B.T.E.). Mechanical Experimental Division, Du Pont Rayon Company, Buffalo, N. Y.
Lewis, LeRoy Clark, IV, '08 (D). Agent, United Filatures Exporting Company, 404 Fourth Avenue, New York City.

Lewis, Walter Scott, IV, '05 (D). President and Treasurer, Alpha Hat Company, Inc., Washington, D. C.
Lillis, Marvin Hale, IV, '14 (D). With Marland Mills, Andover, Mass.
Lindsly, Walter Coburn, IV, '29 (B.T.C.). Textile Chemist, Bigelow Sanford Carpet Company, Thompsonville, Conn.
Linsey, Edward, II, '25 (D). 140 Boylston Street, Malden, Mass.
Logan, George Leslie, VI, '28 (B.T.E.). Assistant to Vice-President, Tompkins Brothers Company, Syracuse, N. Y.
Lombard, Carleton Joshua, VI, '23 (B.T.E.). Salesman, Rodney Hunt Machine Company, Orange, Mass.
Loney, Robert William, II, '22 (D). With General Electric Company, Schenectady, N. Y.
Longbottom, Parker Wyman, IV, '21 (B.T.C.). Chemist and Dyer, Claremont Waste Manufacturing Company, Claremont, N. H.
Lowe, Philip Russell, VI, '24 (B.T.E.). Inspector, Associated Factory Mutual Fire Insurance Companies, Boston, Mass.
Lucey, Edmund Ambrose, II, '04 (D). Consulting Engineer, 53 Park Place, New York City and South Manchester, Conn.
Lussier, Joseph Adrien, II, '27 (D). Staff Superintendent, Hood Rubber Company, Inc., Watertown, Mass.

McCann, John Joseph, Jr., VI, '24 (B.T.E.). 90 Beech Street, Lowell, Mass.
McCool, Frank Leslie, IV, '10 (D). Dyestuff Salesman, Sandoz Chemical Works, Inc., 930 New Industrial Trust Building, Providence, R. I.
McDonald, Gerald Francis, IV, '30 (B.T.C.). With Merrimack Hat Corporation, Amesbury, Mass.
Macdonald, Hector Graham, IV, '19 (B.T.C.). Superintendent of Dyeing, Franklin Process Company, Providence, R. I.
McDonnell, William Henry, I, '06 (C). Lawyer, McDonnell & White, 40 Court Street, Boston, Mass.
McGee, Francis Patrick, IV, '30 (B.T.C.). 94 Beacon Street, Lowell, Mass.
McGowan, Frank Robert, VI, '15 (B.T.E.). Wool Technologist, Bureau of Agricultural Economics, Department of Agriculture, Washington, D. C.
McGowan, Henry Earl, VI, '22 (B.T.E.). Instructor, Lowell High School, Lowell, Mass.
McGuire, Edward Perkins, VI, '28 (B.T.E.). With James McGreery & Co., 5th Avenue and 34th Street, New York City.
Mackay, Stewart, III, '07 (D). Assistant Professor of Textile Design, Lowell Textile Institute, Lowell, Mass.
McKay, Benedict Josephus, IV, '28 (B.T.C.). Chemist, Merrimack Manufacturing Company, Lowell, Mass.
McKenna, Hugh Francis, IV, '05 (D). Chicago Manager, United Indigo and Chemical Company, Ltd., 218 West Kinzie Street, Chicago, Ill.
McKinnon, Norman, VI, '29 (B.T.E.). Textile Testing, Fabric Department, Goodyear Tire & Rubber Co., Akron, Ohio.
McKinstry, James Bradley, II, '25 (D). Superintendent, Millbury Woolen Company, Millbury, Mass.
McKittrick, Raymond Wellington, VI, '28 (B.T.E.). Textile Engineer, F. C. Huyck & Sons, Albany, N. Y.
McLean, Earle Raymond, IV, '30 (B.T.C.). Industrial Fellow, Mellon Institute of Industrial Research, University of Pittsburgh, Pittsburgh, Pa.
MacPherson, Wallace Angus, III, '04 (D). Designer, Wuskanut Mills, Inc. (S. Slater & Sons), Farnumsville, Mass.
Macher, Henry, II, '23 (D). Industrial Research Work, Botany Worsted Mills, Passaic, N. J.
Maguire, James Joseph, II, '28 (D). Assistant Designer, Glenark Mill (Uxbridge Worsted Company), Woonsocket, R. I.
Mahoney, George Stephen, VI, '22 (B.T.E.). Superintendent, Franklin Cotton Mill Company, Cincinnati, Ohio.

Mailey, Howard Twisden, II, '08 (D). Manufacturing Superintendent, Worsted Yarns, Pacific Mills, Lawrence, Mass.
Manning, Frederick David, IV, '10 (D). Planning Department, Pacific Mills, Lawrence, Mass.
Marinel, Walter Newton, I, '01 (D). Automobile Repairing, North Chelmsford, Mass.
Mark, Aris Sawa, VI, '22 (B.T.E.). Sales Department, Overton Textile Company, New York City.
Marshall, Chester Stanley, II, '22 (D). Salesman, Du Pont Rayon Company, Inc., 1504 Land Title Building, Philadelphia, Pa.
Martin, Harry Warren, IV, '11 (D). Management Department, Hood Rubber Company, Watertown, Mass.
Mason, Archibald Lee, VI, '09 (D). Overseer, Lawrence Woolen Corporation, Lawrence, Mass.
Mason, Philip Edwin, IV, '26 (B.T.C.). Salesman and Chemist, Watson Park Company, 470 Atlantic Avenue, Boston, Mass.
Mather, Harold Thomas, VI, '13 (D). Inspector, Associated Factory Mutual Fire Insurance Companies, Boston, Mass.
Mathieu, Alfred Jules, II, '20 (D). Salesman, Wools and Commission Dyeing, Woonsocket, R. I.
Matthews, Elmer Clark, II, '17 (D). Superintendent, Thermo Mills, Inc., West Sand Lake, N. Y.
Matthews, Robert Jackson, VI, '29 (B.T.E.). Salesman, Pacific Mills, 300 West Adams Street, Chicago, Ill.
Mauersberger, Herbert Richard Carl, III, '18 (D). S. R. A. Dyestuff Salesman, Celanese Corporation of America, 180 Madison Ave., New York City.
Mazer, Samuel, IV, '26 (B.T.C.). In business, Dyer and Converter of Yarns, S. Mazer & Co., Mattapan, Mass.
Meadows, William Ransom, I, '04 (D). Cotton Registrar, Chicago Board of Trade, Chicago, Ill.
Meek, Lotta, IIIb, '07 (C). See Parker, Mrs. Herbert L.
Meeker, Samuel, IV, '27 (B.T.C.). Textile Chemist, Textile Dyeing Company of America, Hawthorne, N. J.
Merchant, Edith Clara, IIIb, '00 (C). Supervisor of Art, Lowell, Mass.
Merrill, Allan Blanchard, IV, '11 (D). Manager, Development Department, B. F. Goodrich Company, Akron, Ohio.
Merrill, Gilbert Roscoe, VI, '19 (B.T.E.). Professor of Textiles; in charge of Cotton Yarn Department, Lowell Textile Institute, Lowell, Mass.
Merrill, John Leslie, VI, '27 (B.T.E.). Instructor in Weaving, Lowell Textile Institute, Lowell, Mass.
Merriman, Earl Cushing, II, '07 (D). Died September 30, 1918.
Meyers, Chester William, IV, '27 (B.T.C.). Second Hand in Dyehouse, Massachusetts Knitting Mills, Jamaica Plain, Mass.
Midwood, Arnold Joseph, IV, '05 (D). Salesman, Dyestuffs Corporation of America, 281 Franklin Street, Boston, Mass.
Miller, Joshua, VI, '24 (B.T.E.). Research Associate, Celanese Corporation of America, National Association of Dyers and Cleaners Institute, Silver Springs, Md.
Minge, Jackson Chadwick, I, '01 (C).
Mirsky, Leon Robert, II, '19 (D). 229 West 97th Street, Apartment 3-B, New York City.
Mitchell, Charles Alvah, II, '24 (D). Assistant Superintendent of Woolen Department, Roxbury Carpet Company, Saxonville, Mass.
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Molloy, Francis Henry, II, '16 (D). With The William Carter Company, New York City.
Moore, Edward Francis, II, '25 (D). Planning Department, Rockford Mitten and Hosiery Company, Rockford, Ill.

Moore, Everett Byron, I, '05 (D). President and Treasurer, Chadbourne & Moore, Inc., Chelsea, Mass.

Moore, Karl Remick, IV, '11 (D). Superintendent, Worsted Division, Lorraine Manufacturing Company, Providence, R. I.

Moore, William Joseph, IV, '21 (B.T.C.). Colorist, Pacific Mills, Lawrence, Mass.

Moorhouse, William Roy, IV, '01 (D). Sales Manager, National Aniline and Chemical Company, Inc., 150 Causeway Street, Boston, Mass.

Morrill, Howard Andrew, VI, '16 (D). 1310 South Wilton Place, Los Angeles, Calif.

Morris, Merrill George, IV, '21 (B.T.C.). Chemist-in-Charge, Philadelphia Laboratory, National Aniline & Chemical Co., 200 South Front Street, Philadelphia, Pa.

Morrison, Fred Clifton, I, '03 (D). Died August 21, 1919.

Morrison, Haven Asa, IV, '25 (B.T.C.). Overseer of Dyeing, The Barre Wool Combing Company, Ltd., South Barre, Mass.

Mullaney, John Francis, VI, '20 (B.T.E.). 417 Fairburn Building, Lowell, Mass.

Mullen, Arthur Thomas, II, '09 (D). Superintendent, Maine Woolen Mills, Inc., Camden, Maine.

Munroe, Sydney Philip, I, '12 (D). Chief Cost Expert, Cotton Textile Institute, Inc., 320 Broadway, New York City.

Murray, James, IV, '13 (D). Chemist, Martin Cantine Company, Saugerties, N. Y.

Murray, James Andrew, II, '10 (D). Chocolate Manufacturer, Murene Chocolate Company, 162 Commercial Street, Boston, Mass.

Myers, Walter Flemings, VI, '29 (B.T.E.). Styler, Royal Worsted Company, Lowell, Mass.

Najar, G. George, IV, '03 (D). Dyer and Bleacher, Monument Mills, Housatonic, Mass.

Nary, James Anthony, II, '22 (D). Manager, United States Testing Company, Inc., Chicago, Ill.

Nelson, Roy Clayton, II, '21 (C). Designer, Assabet Mills, Maynard, Mass.

Nelson, Russell Sprague, VI, '22 (B.T.E.). Cost Department, Draper Corporation, Hopedale, Mass.

Neugroschl, Sigmond Israel, I, '21 (D).

Newall, J. Douglas, IV, '09 (D). Superintendent, Bondsville Bleachery & Dye Works, Bondsville, Mass.

Newcomb, Guy Houghton, IV, '06 (C). Manager, Philadelphia Office, E. I. du Pont de Nemours & Co., 128 South Front Street, Philadelphia, Pa.

Neyman, Julius Ellis, IV, '15 (B.T.D.). Furniture Dealer, Neyman Furniture Company, 193–199 Middlesex Street, Lowell, Mass.

Nichols, Raymond Elmore, VI, '10 (D). Draftsman, H. E. Fletcher Company, West Chelmsford, Mass.

Niven, Robert Scott, VI, '12 (D). Section Leader, General Electric Company, Lynn, Mass.

Nostrand, Mrs. William L. (Conklin, Jennie Grace), IIIb, '05 (C). 35 87th Street, Bay Ridge, Brooklyn, N. Y.

O'Brien, Philip Francis, II, '15 (D). (B.S. New York University, M.A. Fordham University.) Chairman, Textile Department, New York Textile High School, New York City.

O'Connell, Clarence Edward, IV, '11 (D). Dyer, National Aniline and Chemical Company, Buffalo, N. Y.

O'Connor, Lawrence Dennis, VI, '17 (D). With Beggs & Cobb, Winchester, Mass.

O'Donnell, John Delaney, I, '04 (C).

O'Hara, William Francis, IV, '04 (C).

Olson, Carl Oscar, II, '24 (D). Scheduling Department, Cheney Brothers, South Manchester, Conn.

Orr, Andrew Stewart, IV, '22 (B.T.C.). Manager, Storey & Co., Brockton, Mass.
Osborne, George Gordon, VI, '28 (B.T.E.). Assistant Professor of Textiles, North Carolina State College, Raleigh, N. C.
Othote, Louis Joseph, I, '23 (D). Designer and Stylist, T. Holt Haywood Department, 65 Leonard Street, New York City.

Palais, Samuel, IV, '18 (B.T.C.). Chief of Planning Department, Durrell Company, 1 Beacon Street, Boston, Mass.
Parigian, Harold Hrant, IV, '28 (B.T.C.). Research Chemist, Cambridge Rubber Company, Cambridge, Mass.
Parker, B. Moore, I, '01 (D). Died December 11, 1918.
Parker, Everett Nichols, I, '05 (D). President, Parker Spool and Bobbin Company, 27–53 Middle Street, Lewiston, Maine.
Parker, Harry Carmi, III, '00 (C). 61 Arlington Street, Boston, Mass.
Parker, Mrs. Herbert L. (Meek, Lotta L.). IIIb, '07 (C). 4 Brookside Circle. Auburn, Maine.
Parker, Hubert Frederic, VI, '20 (B.T.E.). Assistant to Engineer, New York & Pennsylvania Co., and Castanea Paper Company, Lock Haven, Pa.
Parkin, Robert Wilson, VI, '27 (B.T.E.). Cost Accountant, Limerick Mills, Limerick, Maine.
Parkis, William Lawton, I, '09 (D). Assistant Superintendent, Cheney Brothers, South Manchester, Conn.
Parsons, Charles Sumner, VI, '27 (B.T.E.). With Hathaway Manufacturing Company, New Bedford, Mass.
Peabody, Roger Merrill, II, '16 (D).
Pearlstein, Maxwell, III, '28 (D). 37 Lawrence Avenue, Roxbury, Mass.
Pearson, Alfred Henry, IV, '11 (D). Salesman, Ciba Company, Inc., 93 Broad Street, Boston, Mass.
Pease, Chester Chapin, I, '09 (D). Agent, Columbian Mills (Otis Company), Greenville, N. H.
Peck, Carroll Wilmot, IV, '13 (D). Vice-President, George Mann & Co., Inc., Providence, R. I.
Pensel, George Robert, IV, '13 (B.T.D.). Vice-President, Ritter Chemical Company, Inc., Amsterdam, N. Y.
Perkins, John Edward, III, '00 (D). 24 Abbott Street, Pittsfield, Mass.
Perkins, J. Dean, III, '08 (D). Special Agent, Penn Mutual Life Insurance Company, Manchester, N. H.
Perlman, Samuel, IV, '17 (B.T.C.). 506 Belmont Avenue, Newark, N. J.
Perlmuter, Barney Harold, IV, '23 (B.T.C.). Salesman, Mallon Mattress Company, Boston, Mass.
Petty, George Edward, I, '03 (C). With Jefferson Standard Insurance Company, Greensboro, N. C.
Phaneuf, Maurice Philippe, III, '20 (D). 122 Concord Street, Nashua, N. H.
Phelan, Bernard Michael, IV, '29 (B.T.C.). With National Aniline and Chemical Co., 351 Abbott Road, Buffalo, N. Y.
Pierce, George Whitwell, IV, '25 (B.T.C.). Assistant Superintendent of Dyeing, Celanese Corporation of America, Cumberland, Md.
Pillsbury, Ray Charles, I, '13 (D). Manager, Manufacturing Standards Department, Cheney Brothers, South Manchester, Conn.
Plaisted, Webster E., II, '18 (D). Superintendent of Woolens, Pacific Mills, (Worsted Division), Lawrence, Mass.
Plummer, Elliott Barton, IV, '13 (D). Died January 14, 1919.
Potter, Carl Howard, I, '09 (D). Treasurer and Manager, Lola Manufacturing Company, Stanley, N. C., and Globe Yarn Mills, Mt. Holly, N. C.
Pottinger, James Gilbert, II, '12 (D). Director in Charge of Purchasing, Reliance Manufacturing Company, 212 West Monroe Street, Chicago, Ill.
Powers, Walter Wellington, IV, '20 (B.T.C.). Superintendent, Lacquer Division, Fiberloid Corporation, Indian Orchard, Mass.
Pradel, Alois Joseph, III, '00 (D). Designer, Killingly Worsted Company, Danielson, Conn.

Pradel, Mrs. Alois J. (Walker, Anna G.). IIIb, '03 (C). 78 Broad Street, Danielson, Conn.
Precourt, Joseph Octave, VI, '21 (B.T.E.). Western Sales Manager, Cayuga Linen and Cotton Mills, Inc., 437 West Ontario Street, Chicago, Ill.
Prescott, Walker Flanders, IV, '09 (D). Manager, Prescott & Co., Reg'd, 637 Craig Street, West, Montreal, Can.
Prince, Sylvanus Cushing, VI, '08 (D).
Proctor, Braman, IV, '08 (D). Dyestuffs Salesman, General Dyestuff Corporation, 159 High Street, Boston, Mass.
Putnam, George Ives, IV, '16 (B.T.D.). Chief Chemist, McLoughlin Textile Corporation, Utica, N. Y.
Putnam, Leverett Nelson, IV, '10 (D). Overseer of Dyeing, Pacific Mills, Lawrence, Mass.
Putnam, Philip Clayton, IV, '13 (D). Foreman Dyer, Apponaug Company, Apponaug, R. I.

Quinlan, William Harold, VI, '20 (B.T.E.). 171 Highland Street, Worcester, Mass.

Radford, Garland, II, '20 (D). Vice-President, Oriental Textile Mills, Houston, Texas.
Ramsdell, Theodore Ellis, I, '02 (D). Vice-President and Agent, Monument Mills, Housatonic, Mass.
Rasche, William August, III, '03 (D). Deceased.
Raymond, Charles Abel, IV, '07 (D). Superintendent, New England Fuel and Transportation Co,. Everett, Mass.
Redding, Leslie Capron, II, '26 (D). Designer, Selden Worsted Mills, Methuen, Mass.
Reed, Norman Bagnell, I, '10 (D). President and Treasurer, Lowell Mills Company, Lowell, Mass.
Reinhold, Kurt Herman, VI, '28 (B.T.E.). With Russell Manufacturing Company, Middletown, Conn.
Reynolds, Fred Bartlett, II, '08 (D). Purchasing Agent, M. T. Stevens & Sons Company, North Andover, Mass.
Reynolds, Isabel Halliday, III, '03 (C). Clerk, Pacific Mills Print Works, Lawrence, Mass.
Reynolds, Raymond, II, '24 (D). Supervisor, Du Pont Rayon Company, Buffalo, N. Y.
Rice, Josiah Alfred, Jr., III, '20 (D). Manager, Wholesale Ginghams & Wool Goods, Marshall Field & Co., Chicago, Ill.
Rice, Kenneth Earl, VI, '29 (B.T.E.). With Firestone Cotton Mills, Fall River, Mass.
Rich, Edward, IV, '15 (B.T.D.). With Jackson Caldwell Company, East Boston, Mass.
Rich, Everett Blaine, III, '11 (D). "Onacove," Sewall Road, Wolfeboro, N. H.
Rich, Milton Scott, II, '22 (D). Assistant to Purchasing Agent, Harvard University, Cambridge, Mass.
Richardson, George Oliver, IV, '16 (B.T.D.). Manager, Tientsin Office, National Aniline and Chemical Company, Inc., Tientsin, China.
Richardson, Richardson Perry, I, '13 (D). Salesman, H. F. Livermore Company, Boston, Mass.
Riggs, Homer Chase, VI, '17 (B.T.E.). Sales Engineer, Rodney Hunt Machine Company, Orange, Mass.
Ripley, George Keyes, II, '17 (D). General Manager, Troy Blanket Mills, Troy, N. H.
Rivers, William Anthony, II, '24 (D). Assistant Superintendent and Designer, The A. G. Dewey Company, Quechee, Vt.
Robbins, Walter Archibald, VI, '30 (B.T.E.). With Columbia Mills, Inc., Minetto, N. Y.

Roberson, Pat Howell, I, '05 (C). Vice-President, Union State Bank, Pell City, Ala.

Roberts, Carrie Isabel, IIIb, '05 (C). Craft Work, 37 Grace Street, Lowell, Mass.

Robinson, Ernest Warren, IV, '08 (D). Manager Silk Department, J. & P. Coats, Inc., Pawtucket, R. I.

Robinson, Russell, VI, '21 (B.T.E.). Superintendent, Textile Department, Celanese Corporation of America, Cumberland, Md.

Robinson, William Albert, II, '25 (D). 26 Chauncy Street, Suite 5, Cambridge, Mass.

Robinson, William Carleton, III, '03 (C). With A. & P. T. Co., Richmond, Me.

Robson, Frederick William Charles, IV, '10 (D).

Roche, Raymond Vincent, IV, '12 (D). Died September 10, 1926.

Rodalvicz, Francis Rudolph, IV, '28 (B.T.C.). Chemist, American Woolen Company, Andover, Mass.

Royal, Louis Merry, VI, '21 (B.T.E.). Mathematics Department, Pawtucket Senior High School, Pawtucket, R. I.

Rundlett, Arnold Dearborn, VI, '12 (D). Superintendent, Joseph Noone's Sons Company, Peterborough, N. H.

Runnells, Harold Nelson, IV, '25 (B.T.C.). Chemist, Holden-Leonard Company, Bennington, Vt.

Russell, John William, IV, '20 (B.T.C.). Chemist, American Lanolin Corporation, Lawrence, Mass.

Russell, William Samuel, Jr., VI, '28 (B.T.E.). Foreman, Johns-Manville Corporation, Manville, N. J.

Ryan, David Louis, II, '27 (D). Technician of Promotional Sales Department, American Glanzstoff Corporation, 180 Madison Avenue, New York City.

Ryan, Lawrence Francis, IV, '23 (B.T.C.). Chemist, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

Ryan, Millard Kenneth Thomas, Jr., II, '24 (D). Adviser, National Government of the Republic of China, Shanghai, China.

Ryberg, Bertil August, IV, '29 (B.T.C.). Hosiery Dyer, Chenango Knitting Company, Sherburne, N. Y.

Sadler, Thomas Sheridan, II, '30 (D). Construction Work, Massachusetts State Infirmary, Tewksbury, Mass.

Sampson, Clifford William, IV, '28 (B.T.C.). Research Chemist, Tubize Artificial Silk Company of America, 2 Park Avenue, New York City.

Sanborn, Frank Morrison, VI, '19 (B.T.E.). Assistant Superintendent, American Net & Twine Co., West Kennebunk, Maine.

Sanborn, Ralph Lyford, VI, '16 (B.T.E.). Head of Cost Production and Timekeeping Department, Manville-Jenckes Company, Gastonia, N. C.

Sandlund, Carl Seth, VI, '25 (B.T.E.). Research, Prapper-McCallum Hosiery Company, Northampton, Mass.

Sargent, Robert Edward, IV, '25 (B.T.C.). Research Chemist, Tubize Chatillon Corporation, 2 Park Avenue, New York City.

Sargent, Walter Ambrose, I, '22 (D). Instructor, Textile Shop Practice, Public Schools, Passaic, N. J.

Saunders, Harold Fairbairn, IV, '09 (D). With Sherwin Williams Company, Chicago, Ill.

Savery, James Bryan, II, '23 (D). 1514 Engracia Avenue, Torrance, Calif.

Sawyer, Joseph Warren, IV, '15 (B.T.D.). Died May 6, 1926.

Sawyer, Richard Morey, VI, '27 (B.T.E.). (M.S., 1929, Massachusetts Institute of Technology.) Engineering, Firestone Cotton Mills, New Bedford, Mass.

Scanlon, Andrew Augustine, IV, '26 (B.T.C.). 61 Salem Street, Lawrence, Mass.

Schaetzel, Andre Paul, IV, '21 (B.T.C.). Chemist, Associated Dyeing & Printing Corporation, Paterson, N. J.

Schneiderman, Jacob, III, '27 (D). Golf Professional, 700 Blue Hill Avenue, Dorchester, Mass.

Schreiter, Ehrich Ernest Max, VI, '26 (B.T.E.). Engineer, International Machinery Company, Rua Sao Pedro 66, Rio de Janerio, Brazil.

Schwarz, Herman Louis, IV, '22 (B.T.C.). Color Chemist, Sandoz Chemical Works, Inc., 710 Washington Street, New York City.

Scott, Gordon Maxwell, IV, '20 (B.T.C.). 50 Meadows Street, Garden City, L. I., N. Y.

Shaber, Hyman Jesse, VI, '17 (B.T.E.). (M.B.A., 1922, Harvard University.), With Abraham & Straus, Inc., Brooklyn, N. Y.

Shanahan, James Edward, II, '22 (D). Manager, Hygeia Ice & Coal Company, Amsterdam, N. Y.

Shananquet, Mrs. Lee (Woodies, Ida A.). IIIb, '00 (C). Occupational Therapist, Sunshine Sanatorium, Grand Rapids, Mich.

Shea, Francis James, II, '12 (D). With Corticelli Silk Company, Florence, Mass.

Shea, John Francis, IV, '28 (B.T.C.). 41 Myrtle Avenue, Fitchburg, Mass.

Shedd, Jackson Ambrose, III, '28 (D). Designer, Lincolnfield Mills, Lincoln, Maine.

Shelton, Charles Leopold, VI, '29 (B.T.E.). Development Engineer, Mohawk Carpet Mills, Inc., Amsterdam, N. Y.

Shenker, Nahman, III, '25 (D).

Sidebottom, Leon William, IV, '11 (D). Chemist, Boston Blacking Company, Inc., East Cambridge, Mass.

Sjostrom, Carl Gustof Verner, Jr., III, '17 (D). 42 Hampden Street, Springfield, Mass.

Slamin, Alfred Francis, I, '26 (D). Research Department, Nashua Manufacturing Company (Suffolk Mills), Lowell, Mass.

Sleeper, Robert Reid, IV, '00 (D). Textile Colorist, Calco Chemical Company, Bound Brook, N. J.

Smith, Albert Adams, I, '99 (D). Deceased.

Smith, Allen Batterman, I, '26 (D). Head of Mill Department, Turner Halsey Company, 74 Leonard Street, New York City.

Smith, Doane White, II, '10 (D). 15 Oakland Street, Natick, Mass.

Smith, Frank Kenfield, II, '24 (D). Assistant Superintendent, Belding-Heminway Company, Northampton, Mass.

Smith, Herbert Jeffers, VI, '22 (B.T.E.). Overseer of Ring Spinning, Potter Fine Spinners, Inc., Pawtucket, R. I.

Smith, Ralston Fox, I, '04 (C). Sales Manager, W. H. Warner & Co., 1708 Union Trust Building, Cleveland, Ohio.

Smith, Roger Dennis, II, '27 (D). 131 Portland Street, Haverhill, Mass.

Smith, Stephen Eaton, I, '00 (D). Died May 10, 1926.

Smith, Theophilus Gilman, Jr., IV, '10 (D). Farming, Groton, Mass.

Smith, William Charles, IV, '26 (B.T.C.). Research Associate, American Association of Textile Chemists & Colorists, Bureau of Standards, Washington, D. C.

Snelling, Fred Newman, II, '03 (D). With the American Railway Express Company, Haverhill, Mass.

Sokolsky, Henry, VI, '17 (B.T.E.). Time Study Supervisor, B. F. Sturtevant Company, Hyde Park, Mass.

Somers, Benjamin, II, '25 (D). 128 Pleasant Street, Brookline, Mass.

Southwick, Charles Hudson, IV, '22 (B.T.C.). Assistant Dyer, Slatersville Finishing Company, Slatersville, R. I.

Spiegel, Edward, II, '03 (C). 647 West 169th Street, New York City.

Stacey, Alfred Charles, IV, '30 (B.T.C.). Chemist, Washington Mills, Lawrence, Mass.

Standish, John Carver, IV, '11 (D). Superintendent, Albany Felt Company, Albany, N. Y.

Stanley, John Prince, Jr., IV, '29 (B.T.C.). Chemist, Certified Laboratories, Inc., Marble Falls, Texas.

Stass, John George, II, '27 (D). Textile Analyst, United States Testing Company, Inc., 316 Hudson Street, New York City.
Steele, Everette Vernon, IV, '24 (B.T.C.). Purchasing Agent, Rohm & Haas Co., Inc., Philadelphia, Pa.
Stephens, Arnold George, I, '29 (D). 61 Ainsworth Street, Roslindale, Mass.
Stevens, Dexter, I, '04 (D). President, Manville-Jenckes Company, Pawtucket, R. I.
Stevens, Raymond Russell, IV, '19 (B.T.C.). Overseer of Dyeing, The Felters Company, Inc., Millbury, Mass.
Stevenson, Murray Reid, III, '03 (C).
Stewart, Arthur Andrew, II, '00 (D). Professor of Textiles; in charge of Finishing Department, Lowell Textile Institute, Lowell, Mass.
Stewart, John Weeden, IV, '30 (B.T.C.). Textile Colorist, General Dyestuff Corporation, 230 Fifth Avenue, New York City.
Stewart, Walter Lawrence, III, '03 (D).
Stiegler, Harold Winfred, IV, '18 (B.T.C.). (M.S., 1922, Ph.D., 1924, Northwestern University.) Research Work, Cheney Brothers, South Manchester, Conn.
Stohn, Alexander Charles, III, '06 (C). General Superintendent, Carl Stohn, Inc., Hyde Park, Mass.
Stone, Ira Aaron, IV, '09 (D). With Royal Manufacturing Company, Charlotte, N. C.
Storer, Francis Everett, II, '07 (D). With Windham County National Bank, Danielson, Conn.
Storey, Alvin Briggs, VI, '28 (B.T.E.). Assistant Textile Superintendent, Celanese Corporation of America, Cumberland, Md.
Stott, John Smith, III, '28 (D). Assistant Designer, Pacific Mills, Lawrence, Mass.
Stronach, Irving Nichols, IV, '10 (D). Superintendent, Hampton Company, Easthampton, Mass.
Strout, Kenneth Edward, III, '28 (D). Assistant to Manager, American Mills Company, Waterbury, Conn.
Stursberg, Paul William, II, '07 (D). Died in 1913.
Sturtevant, Albert William, IV, '17 (D). Garage Owner, Sturtevant's Repair Shop, 38 Brookside Street, Lowell, Mass.
Sturtevant, Fred William, IV, '26 (B.T.C.). Chemist, and Overseer of Dyeing, Old Town Woolen Company, Guilford, Me.
Suhlke, Waldo Eric, IV, '20 (B.T.C.). 240 East Main Street, Meriden, Conn.
Sullivan, John David, VI, '12 (D). With Robert Gair Company, Bradford, Mass.
Sullivan, Lambert William, II, '23 (D). Salesman, H. M. McCord, 161 Devonshire Street, Boston, Mass.
Sullivan, Willard David, II, '23 (D). 39 Loring Street, Lowell, Mass.
Sunbury, Herbert Ellsworth, VI, '18 (B.T.E.). Mill Manager, Asbestos Spinning & Weaving Corporation, Waterford, N. Y.
Sutcliffe, Henry Mundell, II, '25 (D). Overseer, Uxbridge Worsted Company (Granite Mills), Pascoag, R. I.
Sutton, Leslie Emans, I, '17 (D). Superintendent, Anniston Cordage Company, Anniston, Ala.
Swain, Harry LeRoy, Jr., I, '26 (D). Manager, Cotton and Fabric Department, Firestone Tire & Rubber Co., Akron, Ohio.
Swan, Guy Carleton, II, '06 (D). Chemist in charge of Imports, United States Department of Agriculture, 201 Varick Street, New York City.
Swanson, John Harold, I, '28 (D). Designer, Georgia Kincaid Mills, Experiment, Ga.
Sweeney, George Hamilton, II, '24 (D). Salesman, Walker Stetson Company, 157 Essex Street, Boston, Mass.
Sweet, Arthur Dutcher, VI, '21 (B.T.E.). Died January 27, 1927.
Swift, Edward Spooner, S. J., I, '02 (D). Clergyman, Church of the Immaculate Conception, Boston, Mass.
Sylvain, Charles Emile, VI, '13 (D). Died July 17, 1929.

Syme, James Francis, II, '00 (D). With Mohawk Carpet Mills, Inc., Amsterdam, N. Y.

Symmes, Dean Whiting, IV, '22 (B.T.C.). Salesman and Demonstrator, National Aniline and Chemical Company, 150 Causeway Street, Boston, Mass.

Tang, Hsiung-Yuan, I, '30 (D).5 Assistant Manager, Sung Sing Cotton Mill, No. 3, Wusih, Kiangsu, China.

Tarpey, Thomas Joseph, IV, '27 (B.T.C.). Colorist, National Aniline and Chemical Company, Buffalo, N. Y.

Tarshis, Elias Aaron, IV, '28 (B.T.C.). Assistant Dyer, Gotham Silk Hosiery Company, Inc., New York City.

Teague, Charles Baird, II, '26 (D). Civil Engineer, Highway Division, Massachusetts Public Works Department, Boston, Mass.

Thaxter, Joseph Blake, Jr., II, '12 (D). Vice-President, Ludlow Sales Corporation, 80 Federal Street, Boston, Mass.

Thomas, Roland Vincent, I, '05 (C).

Thompson, Arthur Robert, Jr., IV, '22 (B.T.C.). Southern Manager, Rohm & Haas Company, Inc., 1109 Independence Building, Charlotte, N. C.

Thompson, Everett Leander, I, '05 (D). Salesman, Gulf Refining Company, Brockton, Mass.

Thompson, Henry James, IV, '00 (D). 15 Greenleaf Street, Malden, Mass.

Tilton, Elliott Thorp, II, '99 (D). Died January, 1917.

Todd, Walter Ernest, III, '23 (D). Superintendent, Stanley Woolen Company, Uxbridge, Mass.

Toepler, Carl, IV, '22 (B.T.C.). Chemist, Bellman Brook Bleachery Company, Fairview, N. J.

Toovey, Sidney Ernest, II, '04 (C). Deceased.

Toshach, Reginald Alexander, II, '11 (D). Assistant Superintendent, M. T. Stevens & Sons Company (Pentucket Mills), Haverhill, Mass.

Topjian, Leon, IV, '30 (B.T.C.). Chemist, Hockanum Mills Company, Rockville, Conn.

Toupin, Stephane Frederick, VI, '24 (B.T.E.). Surveyor, Canadian National Railways, Montreal, Canada.

True, William Clifford, II, '22 (D). Industrial Engineer, Chelsea Fiber Mills, Brooklyn, N. Y.

Tyler, Lauriston Whitcombe, II, '16 (D). Manager, W. T. Grant Company, Medford, Mass.

Valentine, Burnet, VI, '23 (B.T.E.). Head of Converting Department, Pepperell Manufacturing Company, 40 Worth Street, New York City.

Varnum, Arthur Clayton, II, '06 (D). Superintendent, Troy Blanket Mills, Troy, N. H.

Villa, Luis Jorge, IV, '25 (B.T.C.). Automobile Dealer, Hijos de Vicente, B. Villa & Co., Medellin, Colombia, S. A.

Villa, William Horace, VI, '24 (B.T.E.). Textile Engineer, Compania Colombiana de Tejidos, Medellin, Colombia, S. A.

Villeneuve, Maurice Arthur, II, '26 (D). With Killingly Worsted Mills, Danielson, Conn.

Vincent, William Henry, III, '26 (D).

Walen, Ernest Dean, VI, '14 (B.T.E.). Agent (Worsted Division), Pacific Mills, Lawrence, Mass.

Walker, Alfred Schuyler, II, '11 (D). 67 Park Avenue, Saranac Lake, N. Y.

Walker, Anna Gertrude, IIIb, '03 (C). See Pradel, Mrs. Alois J.

Walker, Raymond Scott, II, '23 (D). Rate Engineer, Firth Carpet Company, Auburn, N. Y.

Wang, Chen, IV, '23 (B.T.C.).

Wang, Cho, VI, '23 (B.T.E.).

Wang, Tung Chuan, VI, '23 (B.T.E.).

Wang, Yung Chi, II, '21 (D). Factory Manager, Ching Yuen Silk Weaving Factory, Shanghai, China.

Ward, George Chester, IV, '28 (B.T.C.). Textile Chemist, Celanese Corporation of America, Cumberland, Md.

Warren, E. Maybelle, IV, '28 (B.T.C.). Laboratory Assistant, Hub Hosiery Company, Lowell, Mass.

Warren, Philip Hamilton, II, '05 (D). Superintendent, Hopeville Manufacturing Company, Worcester, Mass.

Washburn, John Milton, Jr., IV, '21 (B.T.C.). Salesman and Demonstrator, National Aniline & Chemical Company, Inc., 150 Causeway St., Boston, Mass.

Watson, William, III, '11 (D). Real Estate, Frank E. Watson, 50–54 Merrimack Street, Haverhill, Mass.

Webb, Frank Herbert, IV, '04 (D). Died March 20, 1919.

Webber, Arthur Hammond, IV, '01 (D). With Melville Color Company, 93 High Street, Boston, Mass.

Webster, Joseph Albert, VI, '23 (B.T.E.). Assistant Superintendent, Aberfoyle Manufacturing Company, Chester, Pa.

Weinstein, Edward Joseph, VI, '25 (B.T.E.). Harrison Hardware Company, Harrison, N. Y.

Weinz, William Elliot, IV, '08 (D). Died Feb. 9, 1928.

Wells, Ai Edwin, VI, '20 (B.T.E.). Assistant Professor, Mechanical Engineering, Lowell Textile Institute, Lowell, Mass.

Westaway, John Chester, VI, '28 (B.T.E.). Sales Engineer, Tolhurst Machine Works, Inc., Troy, N. Y.

Westbrooke, Clayton Collington, IV, '29 (B.T.C.). Chemist, Bigelow-Sanford Carpet Company, Thompsonville, Conn.

Wetherbee, Francis Putney, I, '28 (D). Assistant Superintendent, Maverick Mills, East Boston, Mass.

Wheaton, Walter Francis, VI, '23 (B.T.E.). Sales Promotion, Bliss, Fabyan & Co., 32–36 Thomas Street, New York City.

Wheelock, Stanley Herbert, II, '05 (D). President and Treasurer, Stanley Woolen Company, Uxbridge, Mass.

Whitcomb, Roscoe Myron, IV, '10 (D). Pharmacist, R. M. Whitcomb, Ashland, N. H.

White, Royal Phillip, II, '04 (D). Agent, Stirling Mills, Lowell, Mass.

Whitehill, Warren Hall, IV, '12 (D). Chemist, Talbot Mills, North Billerica, Mass.

Wiech, Raymond Edward, IV, '29 (B.T.C.). Assistant Chemist, United Merchants & Manufacturers Management Corporation, 377 Broadway, New York City.

Wightman, William Henry, IV, '06 (D). Salesman, Ciba Company, Inc., 157 Federal Street, Boston, Mass.

Wilcox, Leonard Edward, VI, '24 (B.T.E.). Assistant Manager, W. T. Grant Company, Holyoke, Mass.

Williamson, Douglas Franklin, I, '22 (D). Superintendent, American Net and Twine Company, Blue Mountain, Ala.

Wilman, Rodney Bernhardt, II, '25 (D). Superintendent, New England Fibre Blanket Company, Worcester, Mass.

Wilson, John Sigmund, II, '03 (D). Deceased.

Wilson, Walter Ernest Hudson, I, '04 (C). Deceased.

Wing, Charles True, III, '02 (D). Paymaster, Merrimack Woolen Corporation, Dracut, Mass.

Wingate, Edward Lawrence, Jr., VI, '28 (B.T.E.). Special Representative, Russell Manufacturing Company, Middletown, Conn.

Wingate, William Henry, IV, '08 (D). With United Merchants and Manufacturers Management Corporation, Jewett City, Conn.

Wise, Paul Tower, II, '01 (D). Vice-President, Chelsea Fibre Mills, 1155 Manhattan Avenue, Brooklyn, N. Y.

Woo, Tsunkwei, VI, '19 (B.T.E.). Trading and Engineering, China Industrial Supply Company, Shanghai, China.

Wood, Ernest Hadley, S.B., IV, '11 (D).

Wood, Herbert Charles, I, '06 (D). Died May 14, 1929.

Wood, James Carleton, IV, '09 (D). Sales Representative, R. T. Vanderbilt Company, 230 Park Avenue, New York City.

Wood, Lawrence Burnham, IV, '17 (B.T.C.). Chemist, Lowell Bleachery, Lowell, Mass.

Woodbury, Kenneth Leroy, VI, '28 (B.T.E.). Production Engineering, Cheney Brothers, South Manchester, Conn.

Woodcock, Eugene Close, II, '07 (D). Mill Agent, Chelsea Fibre Mills, 1155 Manhattan Avenue, Brooklyn, N. Y.

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Wu, Clarence Wen-Lon, VI, '25 (B.T.E.).

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Yavner, Harry, II, '12 (D). Hardware Dealer, Mayo's Hardware Company, Jamaica Plain, Mass.

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THE EFFECT OF TWIST UPON THE PROPERTIES OF RAYON YARN

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Lowell Textile Institute.

The material for this paper is based upon two theses performed under the direction of the Textile Engineering Department by Richard S. Cleveland, 1930, and Everton H. Loveless, 1931, during their Senior year and as a requirement for the Degree of Bachelor of Textile Engineering.

The purpose of the investigation was to determine the effect of twist upon certain physical properties of a rayon yarn, namely its breaking strength, ultimate elongation, and counts. It was intended to compare these effects with those changes which are well known to occur in the like properties of a cotton yarn. It was the further purpose to secure data which would make possible a relative estimate of different kinds of rayon under similar conditions of twist.

To obtain these objects, there was purchased from four prominent manufacturers a sufficient quantity of rayon to carry out the tests which had been planned. The rayons selected represented the cellulose-acetate, viscose, nitro-cellulose, and cuprammonium types. Throughout this paper they will be referred to as Rayon No. 1, No. 2, etc., but this order does not refer to that in which they have just been listed. Each was nominally of 150 denier and contained 40 filaments.

The twists selected ranged from 5 to 35 turns per inch in increments of five turns, and are hereafter referred to as the theoretical twists. The actual twists naturally varied somewhat from these values as may be seen in the tabulated summary of results. Twelve bobbins of each twist for each kind of rayon were carefully prepared, and marked with symbols which gave positive identification of the twenty-eight lots thus produced. Ten bobbins of each lot were taken for test purposes.

The actual twists per inch were determined on a precision twist counter, using a 10″ length, and ten determinations were made from each of the ten bobbins of each lot. Each value given in the summary is the average of one hundred tests.

The breaking strengths and corresponding ultimate elongations of the yarns were determined from single strand tests made on a testing machine of 1000 grams capacity. The yarns had been previously conditioned by exposure for three hours in an atmosphere in which the relative humidity was automatically maintained at 65 ± 1%, and the temperature of which ranged from 70° to 75° F. The initial distance between jaws was 250 cm., and an initial weight of 10 grams was applied to the strand before tightening the lower jaw. Proper care was taken to see that the strand did not untwist during insertion in the machine. The speed of the pulling jaw was 12 inches per minute. Ten tests were made from each of the ten bobbins of each lot, so that each value given for breaking strength and elongation in the summary is the average of one hundred readings.

One 120-yard skein was reeled from each bobbin tested for strength, after it had been conditioned as described above. From the average weight in grains of 10 skeins, the counts of the yarn in each lot was thereby determined.

The results of the tests are given in the following table, on the last line of which the breaking strength has been expressed in grams per denier. Some of the data is also expressed in graphical form in the accompanying plots marked A, B, and C. These show, respectively, the grams per denier, ultimate elongation, and denier of the four rayons plotted against the actual twist per inch. The points through which the representative curves were drawn are omitted in the reproduction in order to avoid confusion.

A study of the strengths of the rayons as shown in Plot A, grams per denier versus twist, shows some points of similarity in their behavior and some differences. In the case of Rayon No. 1 the strength increases rather rapidly from 1.3 grams per denier at 5 turns per inch to a maximum of 1.5 grams per denier at about 17 turns per inch. Beyond this point the strength begins to decrease at a rate which appears to be fairly uniform and may be expressed approximately as .1 grams per denier for each 10 turns per inch. Rayon No. 2 shows a less marked

rise in strength from an initial value of 1.01 grams per denier at 5 turns per inch to a maximum of 1.07 grams per denier at about 12 turns per inch. The rate of decrease which occurs beyond this point is uniform and numerically equal to that found to exist for Rayon No. 1. Rayon No. 3 shows a slightly different characteristic It maintains its initial and maximum strength of 1.5 grams per denier at 5 turns per inch unchanged up to about 17 turns per inch, after which the strength begins to decrease at an increasingly rapid rate. Rayon No. 4 resembles No. 3. Its initial and maximum strength of about 1.3 grams per denier at 5 turns per inch is maintained with little change until a twist of about 17 turns per inch is reached. The rate of decrease which then begins to take place is clearly evident from the curve but is not as rapid as in the case of Rayon No. 4.

A study of the stretch of the rayons shown in Plot B, ultimate elongation versus twist, shows for each one a uniformity of increase of percent elongation with increased twist. Straight lines of different slopes correctly average the plotted points within the limits of twist shown. Rayon No. 1 has an elongation of approximately 9% at 5 turns per inch and the rate of increase in ultimate elongation is 3.4% for each 10 turns per inch increase in twist. Rayon No. 2 has an initial elongation of about 20% at 5 turns per inch and its rate of increase is 2.6% for each 10 turns per inch increase in twist. Rayon No. 3 from an initial elongation of 16.5% at 5 turns per inch increases at the rate of 1.0% for each 10 turns per inch increase in twist. At 5 turns per inch, Rayon No. 4 shows an initial percentage of elongation of 18.5 and its rate of increase is 1.6% for each 10 turns per inch increase in twist.

Plot C, denier versus twist, shows a uniform rate of increase in the counts of all four rayons with increase of twist. Rayons No. 3 and 4 show rates of increase which may be expressed numerically as 2.5 denier per 10 turns per inch. Rayon No. 2 shows a rate of increase of 3.5 denier per 10 turns of twist and Rayon No. 1 a rate slightly less than 2.0 denier per 10 turns of twist.

It is interesting to compare the above described changes which take place in these rayon yarns with those which occur in cotton yarns under like conditions. In respect to elongation and counts the two kinds of material show similar behavior, namely increases in elasticity and weight which are at uniform rates.

It is in the matter of strength that the curves (Plot A) for rayon are quite different from the characteristic plot of strength factor (breaking strength x counts) for a cotton yarn. When twist is first inserted into a cotton yarn its strength increases very rapidly, and the counts also increase slightly. Hence its strength factor shows a marked and rapid rise which reaches a maximum for a twist multiplier of about 4.25 to 4.50. This increase is usually attributed to the fact that the fibers are more firmly bound together, thereby increasing their frictional resistance with the consequent reduction of fiber slippage.

The rayon yarns show no such sudden rise in strength. Since they are made up, not of short and non-continuous fibers, but of continuous strands twisted together, no rapid increase of strength would be expected through reduction of fiber slippage and these tests seem to bear this out. Such increases as are shown on Plot A may possibly be due to an improvement in the distribution of the stress amongst the 40 filaments. By binding them together more firmly it makes possible the transfer of the load from one filament to another. The more highly stressed filaments with their consequent tendency toward greater stretch, will partially relieve themselves by increasing the stretch of the adjacent filaments to which they are bound by friction and in this act will transfer a part of their load to their neighbors. Thus there is an approach to equalization of the load amongst the filaments.

For higher amounts of twist both rayon and cotton yarns show decreases in strength. This is probably due in both cases to the increasing magnitude of the torsional stresses set up in the fibers or strands as they are rotated on their axes. A point is reached where the constant increase in this stress more than offsets any beneficial effects which may arise through increased inter-fiber friction or increase in counts, and the strength of the yarn ultimately begins to decrease.

A comparison of the four types of rayon with each other brings out the following facts. In the matter of absolute maximum strength, Rayons No. 1 and 3 stand on an equal footing. Rayon No. 4 is 15% weaker and the strength of No. 2 is 30% less than the strongest. In regard to elongation Rayon No. 2 shows the

greatest value at any particular twist, Rayon No. 1 the least, and Rayons No. 4 and 3 are in second and third place. It would appear that rayons with the greater strength give lower values for elongation and vice versa. Measured by the sum of the average deviations of the mean for all twists, Rayon No. 2 shows the least variability in strength values; Rayon No. 3 is in second place, and Rayons No. 1 and 4 are tied for third place. Applying the same procedure to the average deviations of the means of elongation, the rayons will be found to occupy the same relative standings as last quoted, with Rayon No. 1 showing a slight betterment over No. 4.

SUMMARY OF RESULTS

Rayon No. 1

Theoretical T. P. I.	5	10	15	20	25	30	35
Actual T. P. I.	5.76	9.41	14.21	18.47	23.45	30.23	32.93
Breaking Strength — grams	193.9	218.4	225.5	222.1	231.9	218.4	213.1
Avge Dev. of the Mean — %	.84	.54	.50	.54	.54	.72	.60
Ultimate Elongation — %	8.5	11.2	11.8	13.9	15.4	15.5	18.6
Avge Dev. of the Mean — %	1.66	1.08	1.12	1.09	1.26	1.65	.81
Actual Denier	150.0	152.1	149.0	151.0	155.2	155.5	153.0
Break'g Str. — grams per den.	1.29	1.44	1.51	1.47	1.49	1.41	1.39

Rayon No. 2

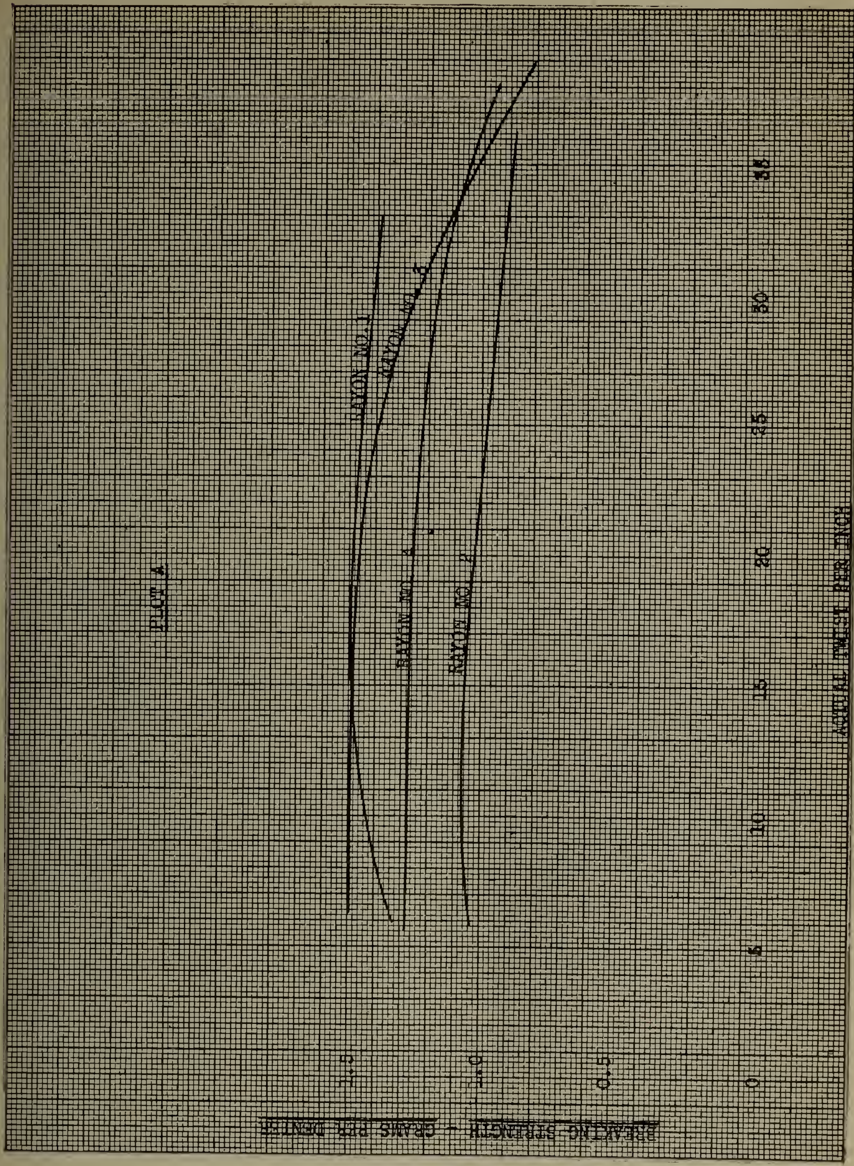
Theoretical T. P. I.	5	10	15	20	25	30	35
Actual T. P. I.	5.76	11.29	15.59	21.02	26.31	32.77	36.16
Breaking Strength — grams	152.0	156.6	158.6	156.0	152.8	139.9	145.6
Avge Dev. of the Mean — %	.44	.48	.40	.30	.32	.42	.32
Ultimate Elongation — %	19.3	21.5	22.6	25.2	26.0	25.7	27.6
Avge Dev. of the Mean — %	1.16	1.13	.91	.60	.99	.73	.60
Actual Denier	147.1	147.2	150.5	151.3	154.0	157.7	159.1
Break'g Str. — grams per den.	1.03	1.06	1.05	1.03	0.99	0.89	0.92

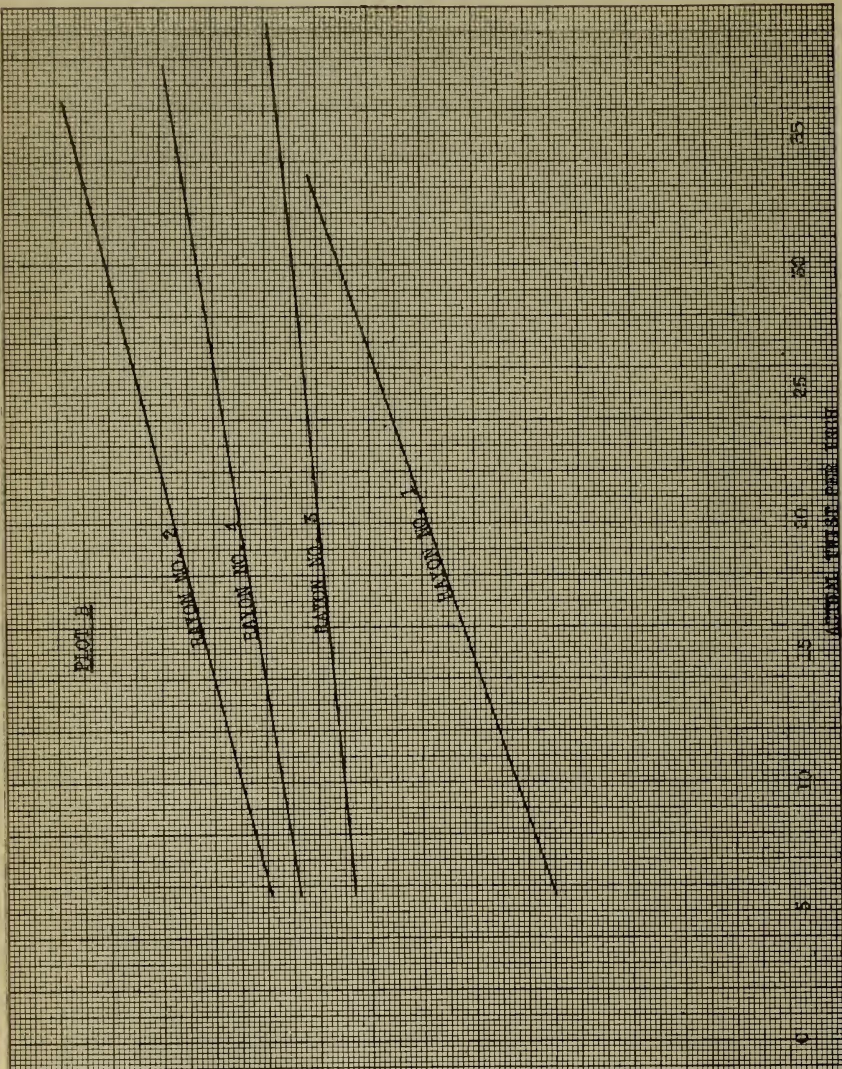
Rayon No. 3

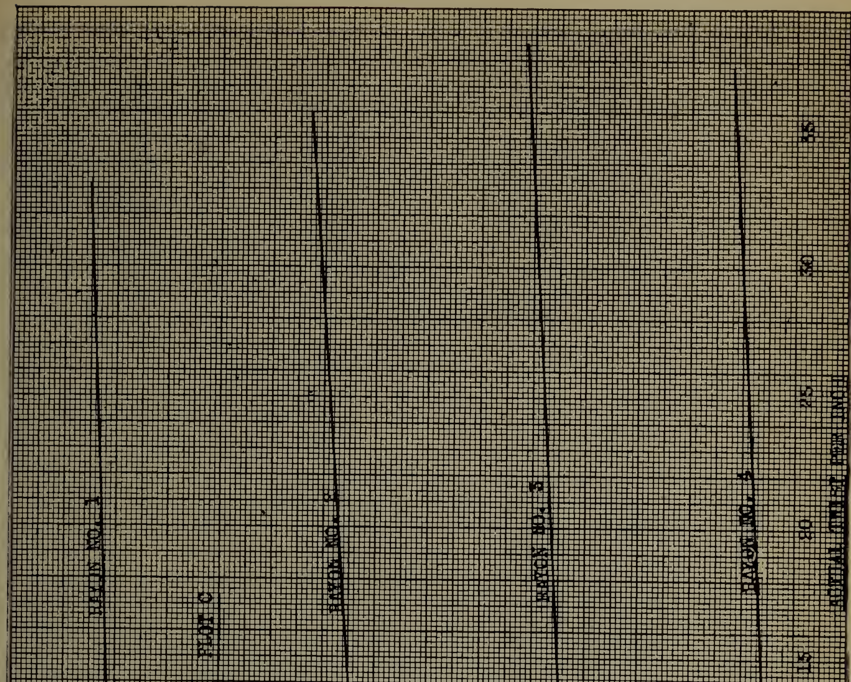
Theoretical T. P. I.	5	10	15	20	25	30	35
Actual T. P. I.	6.14	12.80	15.88	21.22	27.59	33.02	38.64
Breaking Strength — grams	231.8	228.0	230.7	219.8	217.3	162.1	164.1
Avge Dev. of the Mean — %	.44	.48	.48	.48	.60	.46	.44
Ultimate Elongation — %	16.7	18.6	17.1	18.1	17.7	19.4	19.7
Avge Dev. of the Mean — %	.96	1.26	.84	.83	.96	.86	.86
Actual Denier	153.5	154.0	154.5	156.0	156.5	160.5	164.0
Break'g Str. — grams per den.	1.51	1.48	1.49	1.41	1.39	1.01	1.00

Rayon No. 4

Theoretical T. P. I.	5	10	15	20	25	30	35
Actual T. P. I.	5.54	11.29	16.65	21.25	26.27	31.75	37.72
Breaking Strength — grams	200.6	206.2	206.0	204.6	190.9	191.0	181.5
Avge Dev. of the Mean — %	.49	.51	.49	.53	.82	.72	.69
Ultimate Elongation — %	18.5	21.2	20.6	21.4	21.5	23.1	23.5
Avge Dev. of the Mean — %	1.17	1.26	1.18	1.15	1.49	1.41	1.22
Actual Denier	160.5	159.0	160.0	160.0	162.7	165.2	171.3
Break'g Str. — grams per den.	1.25	1.30	1.29	1.28	1.17	1.15	1.06


PLOT A
RAYON NO. 1
RAYON NO. 4
RAYON NO. 2
ACTUAL TWIST PER INCH
0
5
10
15
20
25
30
0.5
1.0
1.5


PLOT
RAYON NO. 2
RAYON NO. 4
RAYON NO. 3
RAYON NO. 1
% ELONGATION
ACTUAL TWIST PER INCH
0
5
10
15
20
25
30
35


PLOT C
RAYON NO. 1
RAYON NO. 2
RAYON NO. 3
RAYON NO. 4
ACTUAL TWIST PER INCH
DENIER
0
5
10
15
20
25
30
35
160
150
155
145
160
150
165
155

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BULLETIN

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Moody Street and Colonial Avenue

DEPARTMENT
OF
LOWELL EVENING TEXTILE SCHOOL

Publication of this Document approved by the Commission on Administration and Finance
2m-7-'31, Order 2832

LOWELL EVENING TEXTILE SCHOOL.

By Act of the Legislature of 1928, the name of the Lowell Textile School was changed to Lowell Textile Institute, and the evening classes are organized and are to be hereafter operated as a department of the Institute to be known as the Lowell Evening Textile School.

CALENDAR.

1931.	
September 24, Thursday	Registration.
October 1, Thursday	Registration.
October 5, Monday	Opening of evening school.
October 12, Monday	Columbus Day—Holiday.
November 26, Thursday November 27, Friday	Thanksgiving recess. No classes.
December 18, Friday	End of first term.
1932.	
January 4, Monday	Opening of second term.
March 4, Friday	Closing of evening school.
April 5, Tuesday	Graduation.

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Assistant Instructor in Mechanical Drawing.
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Assistant Instructor in Chemistry.
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Evening Instructor in Machine Shop.
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Guy Eugene Branch . . . . Forge Village.
Evening Instructor in Worsted Yarns.
Alfred Richard Bachmann . . . . . . Chelmsford Centre.
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Evening Instructor in Freehand Drawing.
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Evening Instructor in Design.
Edward W. Dooley . . . . . . 799 Chelmsford Street.
Evening Instructor in Lettering and Sign Painting.
Kenneth S. Field . . . . 55 Norcross Street.
Evening Instructor in Electricity.
Mollie Marberblatt . . . . . 47 Church Street, Lynn.
Evening Instructor in Freehand Drawing.
Vittoria Rosatto . . . . . . 63 Bradstreet Avenue.
Evening Instructor in Freehand Drawing.

EVENING CLASSES.

GENERAL INFORMATION.

Entrance Requirements.

All applicants to the evening classes must understand the English language and simple arithmetic. Those who are graduates of a grammar or high school are admitted upon certificate. Those who cannot present such a certificate are required to take examination in the subjects of English and arithmetic. In the examination in English a short composition must be written on a given theme, and a certain amount must be written from dictation. In the examination in arithmetic the applicant must show suitable proficiency in addition, subtraction, multiplication, division, common and decimal fractions, percentage, ratio and proportion. Opportunity to register or to take these examinations is offered each year, generally on the Thursday evenings of the two weeks previous to the opening of the evening school.

Registration.

Before entering the class a student must fill out an attendance card, which can be obtained at the office or from the instructors in the various departments.

Any student who has filed an attendance card and who wishes to change his course must notify the office before making the change.

Sessions.

The evening classes commence the first Monday of October and continue for twenty weeks. The school is open on four evenings each week during the period mentioned, except when the school is closed for holiday recesses.

Supplies.

Students must provide their own books, stationery, tools, etc., and pay for any breakage or damage that they cause.

Students' supplies will be sold from the co-operative store every evening school night from 6.45 to 8.15 P.M.

Fees and Deposits.

All evening courses are free to residents of Lowell. To those outside of Lowell the fee is $10 per year for *each course of two nights per week.* Students taking two courses or attending courses requiring more than two nights per week are required to pay $15 per year for three nights and $20 for four nights.

All fees and deposits must be paid in advance.

All students, whether from Lowell or not, taking Course 411, Chemistry and Dyeing Department, are required to make a deposit at the commencement of the course—$5 for first-year students, and $10 for second-year students. A deposit of $10 will be required of all students taking Course 412, 413 or 414. This is to cover the cost of laboratory breakages, chemicals, apparatus, etc., and at the end of the year any unexpended balance is returned, or an extra charge made for the excess breakage.

Every student who takes the chemistry and dyeing course must check up his desk with the instructor of that department when he leaves the school. Any student not doing so will be charged 50 cents.

All students taking Machine-Shop Practice will be required to make a deposit of $5. Any unexpended balance remaining at the end of the year will be returned to the student.

Report of Standing.

A report of standing covering the year's work is sent to all students who attend the entire year and take the necessary examinations.

Certificates.

The courses of the evening school are varied and arranged to meet the special needs of those engaged in the industry. They vary in length from one to four years, and at the completion of each course the certificate of the school is awarded, provided, however, that the student has been in attendance in the course during the year for which the certificate is granted.

GENERAL EVENING COURSES.

The object of these courses is to give young men of ambition an opportunity to obtain instruction in all the branches of science that are allied with their daily work. For example, one who is employed as a weaver in a textile mill may obtain knowledge of the manufacture of yarn, the production of a design, and the methods of finishing a fabric, as well as the manner of its weaving or knitting. In like manner the dyer may augment his knowledge of the chemicals and materials he is daily handling. The engineer and machinist may acquire a knowledge of the mathematics, science of mechanics, electricity and drawing that underlie all the work of an engineer.

It is recognized that the interests of such students lie in a particular field of industry, and these courses are designed to bear directly upon the special line, and supplement, as far as possible, the practical work in which the student is engaged during the day.

In a word, any man having a common school education and the ambition to advance in his line may now secure a broad and comprehensive training in the subjects which will be of vital importance to him in obtaining the goal of his ideal.

A description of all courses follows.

COTTON DEPARTMENT.

110. Cotton Yarns — 3 Years.

The *first year* work in cotton yarn manufacture consists of a study of cotton and its preparation for market, followed by a study of opening, picking, carding and combing. This work consists of lectures on these operations combined with problems that are peculiar to each operation such as the drafts used and the production of each process as well as the amounts of waste made. Special consideration is given to the adjustment and care of these machines and some laboratory demonstration is used to show the manner of adjusting machines for the purpose of controlling the weight of the product, the amount of work done in a day and the control of waste.

Two evenings per week.

COTTON. — Before taking up the details of manufacturing cotton into yarn, a careful study of its physical characteristics is made. The geographical distribution of the areas producing commercial cottons is explained and the characteristics of the cottons produced in each are studied. A general explanation of the cultivation and harvesting of cotton is made, especially emphasizing the effect of agricultural factors on the cotton fiber and how these may serve to complicate manufacturing problems.

The ginning of cotton is considered, showing the yield of lint, the uses of cotton seed and the various types of gins and which cottons are commonly ginned on each.

The intricate system of buying and selling cotton is studied to illustrate the problems a mill may meet in procuring cotton. In this connection, special emphasis is placed on the classification of cottons by staple and by grade.

OPENING AND PICKING. — Instruction in the preliminary operation of opening and picking covers the mechanical construction of the machines, their parts and adjustments, as fully as the manufacturing results accom-

plished by the machines. This includes such construction details as evener, lap measuring and safety stop motions, grids, cleaning trunks and beaters, also operation details which involve the adjustment for waste, drafts and character of laps. Some time is devoted to mixing in its various phases, showing in addition to improvement in uniformity of the product, how cottons are mixed to obtain definite average prices and how different percentages of color may be obtained by mixing, especially on the pickers.

CARDING. — The process of carding is considered one of the most important, and proper time is devoted to the construction and operation of cards that the student may be familiar with the various parts of the card and the function and design of each. The construction and application of card clothing, as well as the methods of grinding, form a part of the work. Some time is given to a discussion of the waste made in carding, the regulation of the amounts of each made and the calculation of the percentages. New and special attachments for various purposes are brought to the attention of the class, illustrating possible ways of improving carding conditions.

COMBING. — The preparation of card sliver for combing by means of the sliver lapper and ribbon lapper, is thoroughly considered. The combing operation itself is studied in considerable detail, emphasizing the general object and operations in combing and the specific means employed by various types of combs in performing the operations. The calculations in this connection involve the drafts and doublings necessary to produce the proper lap for the comb, the proper comb drafts, and the determination of the per cent of noil produced.

The *second year* work includes a study of the drawing and roving processes and the calculations that accompany these operations. It consists of lectures on the machines and demonstration of their adjustment, showing roll setting, draft and twist control, builder adjustment, spacing coils on the bobbin, and tension control.

One evening per week.

DRAWING. — Under this head is taken up the theory of doublings and their effect upon the quality of roving and yarn. Like previous and subsequent processes the machine construction forms an important part of the work. Proper stress is paid to such subjects as stop motions, drawing rolls and their covering, clearers and evener motions.

ROVING PROCESS. — Under this head are studied the various machines known as the slubber, intermediate, fine and jack fly frames. Each of the various motions of these complicated machines is treated separately and then the group is taken as a unit, tying each operation in with the others. Particular attention is paid to the subjects of lay and tension because of their importance in producing perfect roving. The calculations in this subject involve draft, twist, lay and tension with particular attention to the derivation of constants and their use.

During the *third year* the time is devoted to a study of ring and mule spinning, spooling, winding, twisting and reeling, instruction being given by means of lectures and demonstrations. There is also some work done on the combing machine, particularly in the nature of its adjustment. In addition to these subjects, some time is spent on planning the organization of a cotton mill with a view to showing drafts, speeds, productions and number of machines of each kind necessary for the production of a given amount of a certain yarn.

Two evenings per week.

RING SPINNING. — The consideration of spinning yarn by the ring frame method involves a knowledge of the uses to which the yarn is to be put and subsequent methods of handling, that proper roving may be selected, suitable amounts of draft and twist provided, correct size of rings and travelers selected, and building motions suitably adjusted.

Yarn defects are studied with reference to the cause and remedy, necessitating references to many of the earlier operations.

MULE SPINNING. — This method of spinning is very different from that of the ring frame, and the mechanical details are more complicated. The student is furnished with a new means of producing yarns, and can compare the relative advantages of each method. A thorough understanding of mule spinning is perhaps more a study of mechanical motions and their functions. This results almost invariably in assisting the student to understand previous processes and machines better because of his work on the mule. It is the object to make clear to the student's mind the principles underlying the construction and operation of the parts that control the drawing, twisting, backing off and winding, together with such special motions and devices as are used upon the modern mule.

SPOOLING AND WINDING. — The discussions under this head cover the treatment of single yarns, ring or mule spun, in preparation for twisting, comparing the relative merits of spooling with multiple winding on tubes, and beaming for special twisters. Winders are also considered as a means of preparing yarn packages for sale yarns.

TWISTING. — Because of the similarity to ring spinning, the emphasis is more on the manufacturing part of the work, although there are a few peculiar features of a mechanical nature. The twisting of various regular ply yarns, the making of numerous fancy yarns and the principles underlying the production of unlimited patterns is taken up here. The use of special twisters and other apparatus for cords and ropes is considered at this point.

WOOLEN AND WORSTED DEPARTMENT.

210. Worsted Yarns — 2 Years.

During the *first year* instruction consists of a lecture course on the various kinds of wool fibers, trade terms, sorting, scouring, carbonizing, etc., also a course in carding and the calculations involved in the mechanism of the machines, and a course covering gilling and combing and the processes of top making.

RAW MATERIALS. — A study of raw materials which enter into the manufacture of woolen or worsted yarns, or are made into yarns by processes similar to those employed in the manufacture of woolen and worsted yarns, would include silk, mohair, alpaca, vicuna, cashmere, camel's hair and cotton. In connection with these are considered shoddy, noils and extracts.

WOOL SORTING. — Familiarity with the various grades and kinds of wool is obtained by lecture. The various characteristics and properties are explained, as are also trade terms, such as picklock, XXX, XX, ½-blood, ⅜-blood, ¼-blood, delaine, braid, etc. Some skill is acquired in the estimation of shrinkage and in judging the spinning qualities.

WOOL SCOURING. — The object of scouring and the methods employed are explained, and this involves the consideration of soaps and chemicals used in washing; also the waste products and their utilization. A demonstration of a commercial quantity of wool is scoured by machines that are made similar in operation to regular commercial machines. A study is made of the effect of the hardness of water upon soap. At the same time the use of driers, their operation and regulation, is taken up, and the methods of carbonizing wool, noils, burr waste, rags, etc., are studied and explained.

CARDING. — The different systems of carding wool, depending on whether it is to be made into woolen or worsted yarns, are fully explained, as is also the construction, setting and operation of cards. A part of this work consists of a study of card clothing, its construction, application and grinding.

Top Making and Combing. — This branch takes up, besides the carding of the wool on a worsted card, the preparing proceses, backwashing, also gilling of the stock before and after combing. The construction of the gill boxes and combs is studied by lectures. Later, quantities of stock are made into top and then into yarn.

Three evenings per week.

The *second year* is devoted to detail study of the English and French systems of worsted yarn manufacture.

The Noble, Lister and French combs are studied, and the various calculations to determine draft, noiling, productions, etc., are made.

Drawing and Spinning. — The equipment in the laboratory offers opportunity to make worsted yarn by either the Bradford or open drawing system or by the French system. The process includes the various machines in the successive steps of making Bradford spun yarn, and the functions of the different machines are studied. In the latter, or French system, the stock is run through the drawing machines, and the roving spun into yarn on the worsted mule. The same method of studying the mechanism and operations of these machines is followed as in the case of previous methods of instruction. The student by pursuing this course can compare the different methods of yarn manufacture and note the results of each.

With the instruction in spinning by the Bradford system is given work on the twisters and the effects that may be produced.

Three evenings per week.

211. Woolen Yarns — 2 Years.

During the *first year* instruction consists of a lecture course on the various kinds of wool fibers, trade terms, sorting, scouring, carbonizing etc., also of a course on carding, and the calculations involved in the mechanism of the machines.

Two evenings per week.

The *second year* continues the instruction on carding and then takes up a course on the mule and woolen yarn spinning.

Burr Picking, Mixing, Oils and Emulsions. — The use of burr pickers in cleaning wool and the use of mixing pickers in making color blends is covered by lecture and demonstration. Under the subject of oils and emulsions are taken up the characteristics of various oils and the means employed to test them.

Woolen Mule. — The student studies thoroughly the operation of the mule as a whole, and acquaints himself with the various principal mechanisms, as, for example, the backing off and winding motions, the quadrant, builder-rail, faller regulation, etc.

Two evenings per week.

TEXTILE DESIGN AND WEAVING DEPARTMENT.

311. Cotton Design — 3 Years.

During the *first year* instruction is given in elementary designing, starting with all the foundation weaves which may be used in fabrics such as the plain weave, rib weaves, basket weaves, twill weaves, satin weaves, granite weaves, etc. Combination and derivative weaves are made up from the aforesaid weaves. Fancy and figured weaves, in most cases originated by the student, are produced. Color effects, which are so essential in fabrics, obtainable from the different weaves, as stated above, in which the color arrangement of warp and filling create the pattern, are thoroughly considered. Not only the designing, but also harness drafting and the making of dobby chains for any type of weave is taken up.

Cloth analysis is considered in conjunction with designing, as a designer must know the kind of fabric he is designing, what material and what size of yarns are to be used, and how heavy and costly the cloth is to be. The

various topics discussed are the sizes or counts of yarns made from all kinds of fibers, such as cotton, woolen, worsted, silk, rayon, jute and yarns of other vegetable fibers. Their relative length to the pound is determined in the single two or more ply, mixed yarns, novelty yarns and fancy yarns, in the American or English system. The same is given in the metric system. Problems involving the take-up of yarns in the weaving and finishing process are given. Samples of cloth are picked apart to determine their weaves and general construction.

Two evenings per week.

In the *second year* cloth analysis and design are combined in lecture and practice, starting with plain and leading into the more fancy cotton dobby fabrics. A great variety of samples of cloth are used in class work to determine ends and picks per inch, shrinkage in warp and filling, and the number of reed and reed widths necessary for eventual reconstruction. The yarn numbers of warp and filling are determined by aid of fine balances. The amount of warp and filling necessary for a piece of goods is calculated and the weight of a whole piece as well as the number of yards per pound are determined.

Two evenings per week.

In the *third year* more elaborate cloths are considered, both in designing and analysis, cloths in which extra warp or extra filling, or both, are used. Warp backed, filling backed, double, triple or more plied fabrics are taken up, such as marseilles, quiltings, piqué, suspenders, narrow webbings, velveteens, fancy velveteens, velvets, corduroys, Bedford cords, plushes, leno, in fact, anything a student may suggest which might help him in his work.

Two evenings per week.

312. Woolen and Worsted Design — 3 Years.

This course covers the design and analysis of standard woolen and worsted fabrics and is intended for those who wish to specialize in this branch of textile fabric manufacture. Special and fancy fabrics are studied to the extent that time will permit.

During the *first year* instruction is given in the subject of classification of fabrics, use of points or design paper, plain fabrics, intersection, twills and their derivation, sateen, basket and rib weaves, checks and stripes, fancy weaves, including figured and colored effects; producing chain and draw from design, and *vice versa;* extending and extracting weaves.

The analysis of samples is taken up in a systematic manner, illustrating the various cloth constructions for the purpose of determining the design of the weaves and the amount and kind of yarns used, and forms the basis of calculation in the cost of reproducing any style of goods. The various topics discussed are reeds and setts; relation and determination of counts of cotton, woolen, worsted, silk and yarns made from the great variety of vegetable fibers; grading of yarns, folded, ply, novelty and fancy yarns; application of the metric system to yarn calculation; problems involving take-up, average counts, determination of counts of yarn, and weight of yarn required to produce a given fabric.

Two evenings per week.

During the *second year* instruction is given in cotton warp goods, blankets, bath robes, filling reversible, extra warp and filling backs, figured effects produced by extra warp and filling, double cloths and plaid backs.

The analysis work follows as closely as possible the type of fabrics taken up in the designing and the reconstruction of these fabrics with the consideration of their shrinkage and composition.

Two evenings per week.

In the *third year* instruction is given in multiple fabrics, chinchilla, Bedford cords, crepon, matelasse and imitations, double plains, meltons,

kersey, plush and suitings. At this time also is taken up the construction of designers' blankets, suggestion cards, and the construction of samples.

The construction of new fabrics from theoretical viewpoint together with the construction from suggestion cards is taken up. In connection with this work instruction is given in making cost estimates for both woolen and worsted fabrics.

Two evenings per week.

314. Cotton Weaving — 1 Year.

The Course in Cotton Weaving covers instruction on plain looms, Draper Automatic and Stafford Automatic looms. It includes instruction on the construction of shedding and picking motions, take-up and let-off motions together with the operation of the magazines and hoppers and methods of changing shuttle and bobbin. A study is also made of the preparation of warps, beaming, sizing and drawing-in. The Crompton and Knowles Automatic Towel Looms, and the various types of box looms, including chain building and work on multipliers, are also considered in this course.

One evening per week.

315. Woolen and Worsted Weaving — 2 Years.

This course includes instruction on the Crompton and Knowles loom and takes up general construction, head motions, take-up, let-off, filling stop motion, etc. The preparation of warps, wet and dry dressing, is given in connection with this course.

One evening per week.

316. Dobby and Jacquard Weaving — 1 Year.

This course considers the various types of Jacquard heads and dobbies, which includes single cross border dobbies and leno attachments on double lift dobbies, handkerchief motions, leno weaving, center selvedge motions, filling changing looms, oscillating reeds, lappet motions, various shaker motions, towel and other pile cloth weaving. The course on Jacquard looms includes general construction, card cutting, lacing, repeating and fixing.

One evening per week.

317. Freehand Drawing — 3 Years.

The *first year* work consists of charcoal drawing from casts, models, and group arrangements of still life.

Two evenings per week.

During the *second year* instruction is given in pencil sketching, colors, charts and color harmony, pen and ink drawing, and development of original motifs from various sources with color application.

Two evenings per week.

The *third year* work covers original designing for textile fabrics, wall paper and book cover work, pastel and water colors, and oil painting when the time will permit.

Two evenings per week.

CHEMISTRY AND DYEING DEPARTMENT.

Hardly any branch of applied science plays so important a part in our industrial world as chemistry. Many large mills employ chemists as well as dyers, and with the great progress which is being made in the manufacture and application of dyestuffs, a basic knowledge of chemistry becomes an absolute necessity to the dyer. Within a comparatively short distance from Lowell are establishments employing men who require some knowledge of chemistry but who may not necessarily use dyes. Some find a knowledge of analytical chemistry helpful in their everyday work.

To meet these varying needs of our industrial community, the school offers a two-year course in general chemistry, organic and inorganic,

which may be followed by any one of three courses, viz, textile chemistry and dyeing, analytical chemistry, and textile and analytical chemistry. In order to take Course 412, 413 or 414, candidates must have a certificate from Course 411, or show by examination or approved credentials that they have taken the equivalent of the work covered by this course.

411. **Elementary Chemistry — 2 Years.**

General Chemistry, including Inorganic and Organic.

Qualitative Analysis.

One lecture and one Laboratory Period per week in General Chemistry the first year, continued three nights a week during the second year, when the Elementary Organic Chemistry and Qualitative Analysis is completed.

Instruction in Elementary Chemistry extends through two years, and includes lectures, recitations and a large amount of individual laboratory work upon the following subjects:— .

Theoretical Chemistry. — Chemical action, chemical combination, combining weights, atomic weights, chemical equations, acids, bases, salts, Avogadro's law, molecular weights, formulæ valence, periodic law, etc.

Non-Metallic Elements. — Study of their occurrence, properties, preparation, chemical compounds, etc.

Metallic Elements. — Study of their occurrence, properties, metallurgy, chemical compounds, etc.

The students take up, as thoroughly as time will permit, the qualitative detection of the more common metals and non-metals, with practical work.

This work, although necessarily elementary, is intended to prepare the student to study more understandingly the manufacture of dyestuffs and coal tar colors in the more advanced courses which follow.

During the *first year* of the Elementary Chemistry course most of the time is devoted to the non-metals and theoretical chemistry, and the laboratory work covers briefly the non-metals.

Two evenings per week.

During the *second year* the classroom work is upon metals and the hydrocarbons and their derivatives, and the laboratory work consists entirely of Qualitative Analysis. While this course is necessarily taken up in an abbreviated and elementary manner, it is so arranged that the students may become familiar with the separations and the detections of the common metals and acids. This course is also preliminary to the work given in Analytical Chemistry.

Three evenings per week.

412. **Textile Chemistry and Dyeing — 3 Years.**

Lectures in Textile Chemistry and Dyeing.

Laboratory Work in Dyeing.

Covered by 60 lectures and two nights of laboratory work per week.

The outline of the lecture course given in Textile Chemistry and Dyeing is as follows:—

Technology of Vegetable Fibers. — Cotton, linen, jute, hemp, china grass. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Animal Fibers. — Wool, mohair, silk. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Artificial Fibers. — Study of the various forms of artificial silk, the process of manufacture, their properties and action with chemicals, acids and heat.

Operations preliminary to Dyeing. — Bleaching of cotton and linen; wool-scouring; bleaching, fulling and felting of wool; carbonizing; silk-scouring and bleaching, action of soap.

The bleaching of cotton is studied with description of the various forms

of kiers and machinery used; also the action of the chemicals used upon the material, and the various precautions that must be taken in order to insure successful work.

Under this heading is included a study of the reagents used in the emulsive wool-scouring process, and their action upon the fiber under various conditions; also the most successful of the solvent methods of degreasing wool.

WATER AND ITS APPLICATION IN THE TEXTILE INDUSTRY. — Impurities present, methods for detection, their effect during the different operations of bleaching, scouring, dyeing and printing, and the methods used for their removal or correction.

The important subject of boiler waters is also studied under this heading, with a full discussion of the formation of boiler scale, its disastrous results, and the methods by which it may be prevented.

MORDANTS AND OTHER CHEMICAL COMPOUNDS USED IN TEXTILE COLORING, AND CLASSIFIED AS DYESTUFFS. — Theory of mordants, their chemical properties and application, aluminum mordants, iron mordants, tin mordants, chromium mordants, organic mordants, tannin materials, soluble oil, fixing agents, leveling agents, assistants, and numerous other compounds not dyestuffs that are extensively used in the textile industry.

Under this heading are included the definitions of various terms and classes of compounds used by textile colorists, such as color lakes, pigments, fixing agents, developing agents, mordanting principles and leveling agents.

NATURAL ORGANIC COLORING MATTERS. — Properties and application of indigo, logwood, catechu or cutch, Brazil wood, cochineal, fustic, turmeric, madder, quercitron bark, Persian berries. and other natural dyestuffs that have been used in recent years by textile colorists.

MINERAL COLORING MATTERS. —Under this heading are discussed the properties of such inorganic coloring matters and pigments as chrome yellow, orange and green, Prussian blue, manganese brown, iron buff.

ARTIFICIAL COLORING MATTERS. — General discussion of their history, nature, source, methods of manufacture, methods of classification and their application to all fibers.

Besides lectures and recitations upon the subject of Textile Chemistry and Dyeing, practical laboratory work is required. By the performance of careful and systematic experiments the student learns the nature of the various dyestuffs and mordants, their coloring properties, their action under various circumstances, and the conditions under which they give the best results. The more representative dyestuffs of each class are applied to cotton, wool and silk, and each student is obliged to enter, in an especially arranged sample book, a specimen of each of his dye trials with full particulars as to the conditions of experiment, percentage of compounds used, time, temperature of dye baths, etc.

For convenience and economy most of the dye trials are made upon small skeins or swatches of the required materials, but from time to time students are required to dye larger quantities in the full-sized dyeing machines.

413. Analytical Chemistry — 3 Years.

Laboratory Work and Lectures in Quantitative Analysis.

Three nights per week of class-room and laboratory work.

The object of this course is to give the student a general idea of the underlying principles of Analytical Chemistry, with a sufficient amount of laboratory work to enable him to become proficient in performing the ordinary routine analysis of the textile plant. Frequent recitations are held for the discussion of methods and the solution of stoichiometrical problems.

The work covered the first two years is based on Talbot's "Quantitative Analysis," and for the advanced work, consists of the analysis of

soap, water, oils, cloth and other materials of particular interest to the textile chemist, special lecture notes and Griffin's "Technical Methods of Analysis" is used as a text.

414. **Textile and Analytical Chemistry — 4 Years.**

Lectures in Textile Chemistry and Dyeing.

Laboratory Work in Analytical Chemistry.

Combines all lectures in Textile Chemistry and Dyeing with work of Course 413, but does not include any Dyeing Laboratory.

Three nights per week.

TEXTILE ENGINEERING DEPARTMENT.

This department has arranged to offer those courses of study which lie at the foundation of all engineering. These are designed to give to those engaged in the mechanical, electrical, and manufacturing departments of mills, factories and other industrial establishments an opportunity to learn something concerning the theory underlying the many practical methods which they use in their daily work. Those subjects for which there is usually a regular demand are listed and described below, but similar and allied courses will also be arranged for provided there is a sufficient demand. In the case of all courses there must be an enrollment of at least ten properly qualified students to warrant giving the subject.

613. **Mechanical Drawing — 3 Years.**

For one having occasion to make a sketch or detail drawing for the purposes of illustration or instruction, or for one who is daily required to work from a drawing or blue print, the course in Mechanical Drawing is offered. It first lays a foundation of the principles of mechanical drawing, and follows this with two years' work in drawing directly from parts of machines, preparing both the detail and the assembly drawing.

614. **Machine Shop Practice — 2 Years.**

This course is a complete course in drawing and requires *two evenings per week* for three years for its completion. The work is so planned that at its completion a man shall be thoroughly familiar with the making of a working or shop drawing. After a study of the underlying principles of projections and instruction in penciling, inking, lettering and tracing, the subject of sketching and the making of detail drawings therefrom is especially stressed. The preparation of assembly drawings is finally considered.

This course offers an opportunity to learn the art of metal working and is equally valuable to the man who already has some knowledge of the methods employed as to one who has no knowledge of the same. Thus it becomes possible for one who may be working at the bench during the day to learn how to operate a lathe or other machine tool, or for a lathe hand to acquire a knowledge of a planer, shaper, milling machine, or grinder. A series of lectures is given on the care and management of tools, tool grinding, and the mechanism of the machines. A man who only has a knowledge of the special machine he operates may by means of this course become a more intelligent machinist. He should supplement this study with the courses in Mechanical Drawing, and in Mechanics and Mechanism, in order that his training for an all-round machinist or mechanic may be more complete. The time required is *two evenings per week.*

619. **Mechanics and Mechanism — 2 Years.**

This is one of the most important of engineering subjects dealing as it does with the principles which underlie the transmission of force and motion through machines and mechanical devices. Its principles are so fundamental and so widely used in more advanced subjects that the student should not consider himself qualified for further work until he has mastered the principles of this subject.

Beginning with a discussion of such important topics as work, power, horsepower, energy and the like, the student then studies the fundamental mechanical principles which are exemplified by the lever, jackscrew, pulley block, inclined plane, wedge, differential pulley and other similar devices. This is followed by consideration of the simpler relations pertaining to uniform and accelerated motion and the course concludes with a study of pulleys, belting, gears and gearing, as far as time permits. No student should undertake this course who is not thoroughly familiar with elementary mathematics. This subject requires attendance *two evenings per week* with home problem work and the study of a text book.

620. Mathematics — 2 Years.

This course is designed to permit the student to pursue further by evening study the mathematics of his grammar or junior high school course. It includes algebra, elementary trigonometry, logarithms and slide rule, and requires attendance for *two evenings per week.* It should be taken by all who intend to study further into engineering subjects. Instruction is largely through problem work in class and at home, and the use of a text book.

Some of the topics treated are—

Elementary algebraic operations of—

- Addition.
- Subtraction.
- Multiplication.
- Division.
- Factoring.
- Fractions.
- Graphical representation.
- Linear equations.
- Radicals.
- Quadratic equations.
- Logarithms.
- Slide rule.
- Trigonometry.

621. Strength of Materials — 1 Year.

This interesting subject deals with those important principles whereby the person engaged in machine, engine, mill or building design may ascertain whether the parts are strong enough to carry the forces and loads which the nature of the construction imposes upon them.

The fundamental stresses of tension, compression and shear are first considered, together with the ultimate strength of cast iron, wrought iron, steel, and timber. The practical use of this information is illustrated in the design of bolts, tie rods, columns, wall piers, boiler shells, riveted joints, etc. This is followed by a study of the stresses in and design of beams under various conditions of loading, and the course concludes with a discussion of the torsional stresses and twist in shafts. A knowledge of the principles of Mechanics and Mechanism is highly desirable to a satisfactory understanding of this subpect. The time required is *one evening per week* and the method of instruction is through lectures, recitations, problems, and the use of a text book.

622. Steam — 1 Year.

It is the purpose of this course to study the various methods of heat generation, transmission, and utilization in use at the present day and to learn the theoretical relationship which underlie these processes and transformations.

The instruction covers, so far as time permits, the elements of steam engineering. The topics covered are heat and its measurement, use of steam tables, types of boilers, engines and turbines, boiler and engine room accessories, together with a study of the methods of testing the various types of apparatus. Actual tests on such equipment are made as the size of the class permits. Text books, laboratory and class work, and home problems are the methods of instruction used, requiring an attendance of *two evenings per week.*

623. Direct Current Electricity — 2 Years.

This popular course is planned to cover the fundamentals of direct current circuits and machinery. The lectures on electrical theory are supplemented by laboratory work and the use of a text book and problems. It requires for its completion attendance for *two evenings per week* and a considerable amount of home study and preparation. Students who wish to take this subject must have studied one year of algebra.

The fundamental properties of electrical and magnetic circuits are studied both in the classroom and laboratory. Other topics include the measurement of resistance, the calculation and measurement of power in direct-current circuits, and the relation between the electrical, heat and mechanical units of energy. A large amount of laboratory and class work is given to make the student familiar with methods of operation, testing and control of direct current machinery.

624. Alternating Current Electricity.— 2 Years.

This course is similar to course 623 except that it deals with alternating current circuits and machinery. No student should plan to take this course unless he has previously taken at least one year of Course 623 or can show that he has had the equivalent.

The fundamental properties of alternating current circuits are first considered, and are followed by a study of the operation of alternating current machinery. The study of electrical measuring instruments is also included in this course. The instruction is given by means of lectures, recitations, and a large amount of laboratory work. An attendance of *two evenings per week* is required.

625. Power Plant Testing — 1 Year.

The purpose of this course is to teach the operating engineer how to test the various units usually found in a power plant. Numerical calculations are introduced and the interpretation of the results is of primary importance.

The following are some of the machines tested: engine, turbine, triplex pump, centrifugal pump, injector, etc. Various gages are also calibrated.

A test book is required and the class is held *two evenings per week.*

626. Mill Illumination — 1 Year.

Because of the demand by mill men, this course is now offered to evening students and requires an attendance of *two evenings per week.*

Safety and production, factors entering into the design of lighting installations, industrial codes, costs and estimates are carefully considered. The laboratory exercises include the study of photometric curves of industrial units, study and use of the photometer, study of illumination by means of the Macbeth Illuminometer, and foot-candle meter.

The concluding work will be the complete design of a lighting installation, using the Institute laboratories or a local mill room.

Owing to limitations in apparatus, this course is open to a limited number of qualified men.

Accounting Classes (Division of University Extension)

Classes in Elementary, Advanced and Cost Accounting have been offered in past years at the Lowell Evening Textile School under the auspices of the Division of University Extension, State House, Boston, Mass. Their continuance is dependent upon a sufficient expression of interest in them. Outlines of the courses, fees, etc., may be obtained by inquiry at the above address or by addressing the school.

FINISHING DEPARTMENT.

In these courses machine work is supplemented by lectures and discussions pertaining to the many finishes given to fabrics. The action of soaps, water, steam, heat and cold upon cloth containing one fiber or combination of fibers as used in commercial fabrics is carefully studied.

These courses also help the finisher to broaden his knowledge of textile fabrics. Attendance is required for *two evenings per week.*

710. Woolen and Worsted Finishing — 1 Year.

The outline of this course, which is given chiefly by means of lecture work, is as follows:

BURLING AND MENDING. — Under this head are taken up for consideration the examination of flannel as it comes from the loom; the construction, use and location of the perch; the methods used in marking defects, measuring, weighing and numbering of cloths; also the methods of inspection for fancies, single cloths and double cloths. The object of burling, mending and the types of tables employed, the method of removing knots, runners, etc., the object of back shearing and the use of burling irons, the replacing of missing threads and the importance of sewing as a part of the finishing process, are also considered in detail. The removal of oil and tar spots as well as stains of various kinds is studied.

FULLING. — This branch covers a study of the conditions of the flannel as it comes from the loom, and the influence of oil, etc., upon the procedure. Considerable time is devoted to the various methods of producing a felt, the various types of stocks and their modifications and development into the present type of rotary fulling mills of both single and double variety. The details of construction in all machines are carefully taken up and include the design and composition of the main rolls, method of covering, regulation and means of adjusting the pressure of traps and rolls, and the use and regulation of the various types of stop motion, the different types of stretchers, guide rolls and throat plates.

The theory of felt is taken up and the influence of pressure, moisture, heat, alkali and acid is considered, as well as the hydroscopic and felting properties of different wool fibers. The preparation of the flannel for the mill and the usual methods of determining shrinkages, as well as the various methods of soaping, are given careful attention. The preparation of various fulling soaps and the value of each for the production of various degrees of felt, as well as the determination of the proper amount of alkali for various goods, are carefully studied and demonstrated. The manipulation of the various kinds of goods in the mill, viz., all wool, reworked wools and mixed goods, is studied in classroom and by operation in the laboratory.

The change in weight and strength for each operation is carefully considered, as is also the value of the flocks made in each. A study of the various methods of flocking, such as dry and wet, is considered in both class and machine rooms. In each operation the defects likely to materialize are studied, as well as the cause thereof, and various methods of modifying or lessening them.

WASHING AND SPECK DYEING. — This branch considers the scouring, rinsing and washing of goods both before and after the fulling process; the various types of washers; and the details of construction, such as suds box, rolls, etc. The theory of scouring, uses of Fullers' earth, salt solutions and sours on the different kinds of goods are made clear by practical work in the machine room, where the effects due to improper scouring, such as stains, cloudy effects, wrinkles and unclean goods, are demonstrated. The discussion of the necessity of speck dyeing follows naturally from the study of these matters, and includes methods of preparation, materials used, application and tests required.

CARBONIZING.—This is an important branch of finishing, and includes a study of the various carbonizing agents, methods of application, strength of solutions and neutralizing, as well as the machines used. Stains and imperfections resulting from carbonizing are also considered. The drying and tentering machines and extractors employed are taken up at this point.

GIGGING, NAPPING AND STEAMING. — The construction in detail of the various types of gigs, nappers, steamers, wet gigs, rolling, stretching, crabbing and singeing machines is discussed, and their actions upon the cloth and the results obtained are explained.

Various methods of obtaining luster and the production of permanent finish are considered in connection with steaming and sponging.

BRUSHING, SHEARING AND PRESSING. — This includes, as do the other branches, a careful treatment of the machine employed, the preparation of the cloth for each process, the action of each machine in producing its part of the resultant effect. In the manipulation of the shear consideration is given to its setting, grinding and adjustment. With the brushing machine the effect of steaming and moisture upon the luster and feel of the goods is shown. A study of the action of the presses, both plate and rotary, involves consideration of pressure, steaming, etc. Special processes to obtain particular effects are taken up, and the part played by each machine is explained. The details involved in handling cloth on a commercial scale, as, for example, measuring, weighing, ticketing, numbering and rolling, are also explained. The necessary calculation and the methods of finishing all grades of goods are considered from time to time during the year.

Two evenings per week.

711. **Cotton Finishing — 1 Year.**

The outline of the course in the finishing of cotton fabrics is as follows:—

CLOTH ROOM. — Instruction of the various goods and the objects thereof; construction of the various types of inspecting and trimming machines.

SHEARING. — The object. A consideration of the various types of shears for treating one or both sides at the same time; also the use of the usual cleaning devices, such as emery, sand and card rolls, beaters and brushes; grinding and the adjustment of the various parts.

The use of brushing and cleaning machines, rolling devices and calender attachments for gray goods.

SINGEING. — Developing and object of singeing; the construction of singers of all types, and for various purposes; the use of cooling tanks, steaming devices, rolling and brushing attachments.

Regulation of the flame for various goods, and adjustment of the parts; gas and air pressure, water-cooled rolls; the effect of moisture on the cost of singeing; the use of dry cans in connection with singeing; electric singeing.

WASHING. — Open width and string washers, their construction and operation; soaps, temperature, squeeze rolls; washing of various goods and the object thereof; stains.

NAPPING. — The object of napping and the usual method of treating goods; various types of nappers, single and double acting; felting nappers; construction, grinding and adjustment of various types.

WATER MANGLES. — Their object and construction of various types; various rolls,—iron, husk, etc.; scutchers, their object and construction.

STARCH MANGLES.—The object and construction of all types of starch mangles for pure starch and filled goods; various types of rolls, — brass, rubber, wood; action of doctor blades, etc.; regulation and object of pressure.

Methods of starching and finishing all standard goods, also a consideration of the various substances used, such as starch, softener and fillers; the preparation of starch and various methods of application.

DRYERS AND STRETCHERS.—Both horizontal and vertical, tenter frames, clips; the swing motion and the finishes thus produced; construction; spraying machines, belt stretchers, button breakers; their object and construction.

Calenders. — The object and construction of all types, including the regulation of pressure and nips for the production of various finishes; various types of rolls and their uses,—steel, husk and paper; the use of hot and cold rolls; chasing, friction, embossing and Shriner calenders and the various finishes produced by each; production of watered effects; beetling machines.

Making up room, — yarding, inspecting; different types of folds; pressing, papering, marking.

Two evenings per week.

EVENING GRADUATES OF 1931.

Certificates awarded as follows, April 7, 1931:

Cotton Manufacturing — 4 Years.

Walden Elbridge Bassett	Andover
Ian Hamilton McKay	Lowell
Jules Von Dittweiler	Lawrence

Knitting — 1 Year.

Eugene Herbert Anderson	Lowell
Ellsworth Otis Caldwell Hill	Andover
Karl Frederick Gustav Maier, Jr.	Lowell
Herbert Neild	Lowell

Woolen Manufacturing — 4 Years.

Richard Clarenbach	North Andover

Woolen Yarns — 2 Years.

Alfred Beaumont	Methuen
Philip Ray Chesbro	Methuen

Worsted Yarns —2 Years.

Fred Butterworth	Lawrence
James Joseph Lamb	Lawrence
Charles Addison Shields	Lawrence

Cotton Design — 3 Years.

Mary Porter Burnham	North Andover
Sidney Wallace Greeley	Lowell
Edgar Greenwood	Lowell
Thomas Fletcher Thomson	Lowell

Woolen and Worsted Design — 3 Years.

Melvin Frank Carter	Chelmsford
Byron Lambert Clough	Dracut
Robert Matthews	Lowell
John Leslie Merrill	Lowell
Francis Henry Sloan	Lowell
Francis Robert Wilson	Dracut
James Raymond Wylie	Lowell

Freehand Drawing — 3 Years.

Dorothy Douglas	Lowell
Marion Elizabeth Kane	Lowell
Irene May Russell	Lowell
Walton Spence	Lawrence
Rose Vaccaro Trio	Lowell

Cotton Weaving — 1 Year.

Joseph Daniel Casey	Lawrence
Frank Edward Chateauneuf	Methuen

Ernest Hyde Helliwell	Methuen
Olen Franklin Marks	Lowell
Gerald O'Connell	Manchester, N. H.

Dobby and Jacquard Weaving — 1 Year.

William Chester Chenard	Lowell
Henry Chester Langworthy	Dracut
Maurice Wilfred Lanseigne	Lowell
Francis Robert Wilson	Dracut

Woolen and Worsted Weaving — 2 Years.

Maurice Wilfred Lanseigne	Lowell
Elmer Eino Mikkola	Lowell
Claude Alfred Taylor	Methuen
Laurie Stanford Baker	Methuen

Cotton Finishing — 1 Year.

Louis Lipschitz	Lawrence

Woolen and Worsted Finishing — 1 Year.

John Rostron Berwick	Andover
John Andrew Calnin	Lowell
William Alfred Hill	Lawrence
Herbert Murray	Lawrence
Nelson Leroy Pratt	Lawrence
James William Starr	Lawrence
Leslie Landor Walmsley	Methuen
Herman Winway Weinhold	Lawrence

Textile Chemistry and Dyeing — 3 Years.

William Austin Ainsworth	Lawrence
Luther Anteblian	Lowell
Paul Robinson Hammond	Methuen
Albert Christian Johnson	North Andover
Joseph Patrick Kenefick	Lowell
Arthur William Meister	Methuen
Sam Parry	Methuen
Benjamin Franklin Pulsifer	Nashua, N. H.
Emery David Spurr	Lowell
Erwin Wilkinson	Lowell

Elementary Chemistry — 2 Years.

Augustine Xavier Doyle	Lawrence
Edmund Joseph Fogarty	North Andover
Roland Octave Gagnon	Lowell
James Joyce Galvin	Lowell
David Hall	Littleton Common
Carl Herbert Kruschwitz	Lawrence
William Carol Kulpinski	Lawrence
Anna Grace Mack	Lowell
Francis Alexander Mathews	Lowell
John Bernard Moran	Methuen
Harold Mudd	Lawrence
Nicholas Normand Nicholas	Lowell
Francis Henry William Nowak	Lowell
Edward Joseph O'Hare	Lowell
Alfred Halliday Peel	Methuen
James Lamont Phillips	Andover
James Quance	Methuen
Alexander Ritchie	Methuen

Raymond William Schernig	Lawrence
Louis Adrien Sicard	Lowell
Weston Earl Swanson	North Billerica
Robert Edson Tacy	North Andover
James Alexander Taylor	North Andover
May Agnes Winslow	Lawrence
George Robert Thompson	Lowell

Mechanical Drawing — 3 Years.

Thomas Henry Clowrey	Lowell
William John Eddy	Lowell
Arthur Omer Leclair	Lowell
Harry Joseph McGuinness	Lowell
Ernest Henry Martin	Lowell
William James O'Neil	Nashua, N. H.
Franklin Woodill Porter	Lowell

Mathematics — 2 Years.

Lester William Bell	Lowell
Charles Anthony Clark	Lawrence
William Faulkner Conant, Jr.	Lowell
Francis Delaney	Forge Village
John Alfred Ebhardt	Lawrence
William John Eddy	Lowell
Clifford Hartley	Lowell
Edwin Charles Hughes	Lawrence
Frederick Bazil Kay	Lowell
Carroll Andrew McCarthy	Lowell
George Michael McDonough	Lowell
Everett Edwin Perkins	Lowell
Norman Alfred Sykes	Methuen
Donald Ellsworth Wright	Westford

Steam — 1 Year.

Leonard Arthur Aube	Lowell
James William Gagnon	Lowell
Paul Louis Mertrud	Lowell
Leander David Ranney	Nashua, N. H.

Mill Illumination — 1 Year.

Roy Edward Blanchard	Graniteville
Wilfred Bottomley	North Andover
Harry Sidney Forty	Graniteville
Edward George Haines	Lowell
Clarence Wadsworth Hope	Lowell

Machine Shop Practice — 2 Years.

Karl Alden Ilsley	Lowell
Carl Benjamin Laidlaw	Lowell
John David Manning	Lowell
Earl Woodbury Sawyer	Lowell
Joseph Kazimir Strelcin	Lawrence

Direct Current Electricity — 2 Years.

Thurland Arthur Bartlett	Nashua, N. H.
Gerald William Gross	Lowell
Henry Homer Martell	North Billerica
Arthur William Rother	Lawrence
Frank Frederick Twarog	Lowell

Alternating Current Electricity — 2 Years.

Francis Wilber Anderson	Nashua, N. H.
Adolph Edward Cielakie	Lowell
Arnold Stuart Gailey	Lowell
Lemuel Raymond Gallagher	Nashua, N. H.
Lester John Gibson	Lowell
Hagop Karabashian	Lawrence
Wycliffe Maidment	Lowell
Michael William Schofield	Lawrence
Dewey Dorius Surprenant	Tewksbury

SERIES 35, No. 2

November, 1931

BULLETIN

OF THE

Lowell Textile Institute

LOWELL, MASS.

Issued Quarterly

1931-1932

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under Act of Congress of July 16, 1894.
Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized October 21, 1918.

Moody Street and Colonial Avenue

Publication of this Document approved by the Commission on Administration and Finance
2500. 12-2-'31. Order 4015.

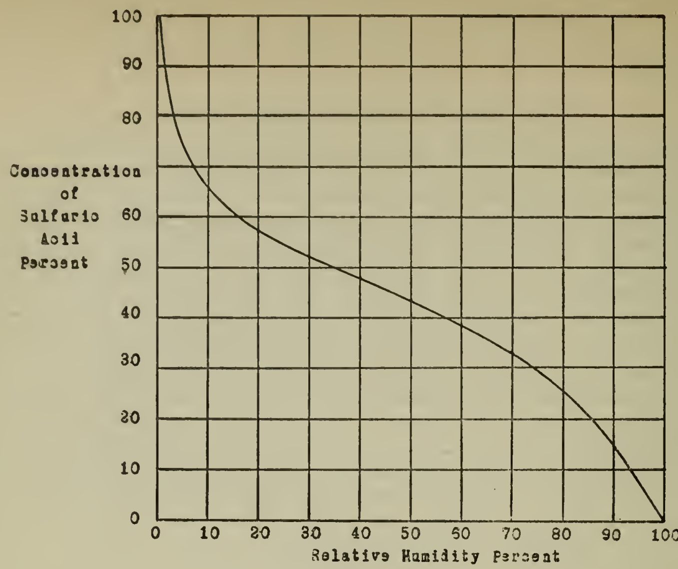

Figure 1

Temperature Corrections

It must be realized that although the relative humidity in such an arrangement is independent of the temperature, the hygroscopic properties of the materials will without doubt be seriously affected by changes in temperature. Therefore, the whole apparatus must be kept at constant temperature if accuracy is aimed at. This is an important consideration and must not be neglected. Where corrections for temperature must be made, the following relation originally pointed out by Hathorn and given by Matthews[3] may be used.

$$R = k\frac{1}{T}$$

Where R=regain

T=absolute temperature

This relation is valid only for unbleached cotton.

Further Corrections

For very accurate work a further refinement must be added. Since the material will probably not be introduced into the humidifier at the moisture content desired, it must be borne in mind that the water which passes into or out of the material comes from or goes into the acid solution thereby changing its concentration. In any case, care should be taken to introduce the sample in as near its final state of regain as possible, and to use as large a volume of acid solution as possible. Where extreme accuracy is aimed at or where it is necessary to use a small volume of humidifying solution, it will be necessary to titrate the acid after equilibrium is reached and correct for any significant changes in acid concentration.

Use of Other Solutions

The data given above will be found satisfactory for all work unless it must be left in the humidifier a long time. Under these conditions it has been found that the sulfuric acid fumes tender the cloth. It has also been found by Armstead and Howland[4] that molds will not grow in an atmosphere humidified by sulfuric acid solutions. These latter report excellent results using solutions of phosphoric acid. Unfortunately they do not give data from which suitable solutions may be reproduced. Some work has been done in the laboratories of the Lowell Textile Institute by the author and his students to determine the necessary concentrations, but sufficient data has not yet been collected to warrant publication. It is hoped that this may be presented in the near future.

Barr[5] recommends a solution of calcium chloride for humidifying where long exposures are necessary. His data was taken from the vapor pressure determinations of Paranjpe[6]. It is reproduced in Table II and shown graphically in Figure 2. While these solutions are not as easy to analyze as sulfuric acid solutions, they may be approximately determined by density measurements. It will be noted that Table II gives the data in terms of specific gravity. Table III gives the same data in terms of degrees Twaddle, as this scale is more often used by the textile chemist than the former. The precau-

Table II

% Relative Humidity	Specific Gravity Calcium Chloride Solution $\frac{15°}{4°}$
40	1.395
50	1.349
60	1.302
70	1.252
80	1.195
90	1.121
100	0.999

Table III

% Relative Humidity	Density Calcium Chloride Solutions, Degrees Twaddle
40	79.0
50	69.8
60	60.4
70	50.4
80	39.0
90	24.2
100	00.0

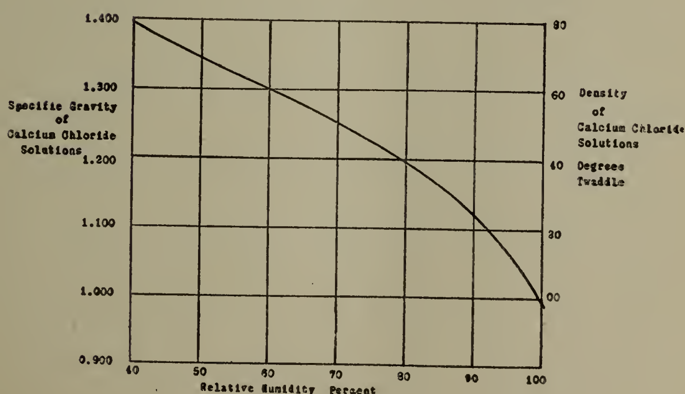

Figure 2

tions noted under sulfuric acid hold equally here, viz., large volume of solution, or if this is impossible, measurement of the concentration at the time the sample is removed. The temperature relations are the same as for the acid; relative humidity independent of temperature, but regain affected by changes of temperature. A serious drawback to the universal use of calcium chloride solutions is that they cannot be employed to give relative humidities less than 40%.

Barr[5] finds it possible to dispense with a conditioning room and still do accurate testing by using a large wooden box (3 feet on a side) containing in the base, a tray of calcium chloride solution of the proper strength. He adds a small electric fan in order to keep the air uniform throughout this large volume. Wet and dry bulb thermometers were added so that the humidity might be read directly. If these are correctly placed in relation to the fan, there is sufficient movement of air past the wet bulb to permit the use of the more accurate psychrometric tables.

By use of one or both of the methods given above, the laboratory worker will be able to maintain his samples at any degree of humidity with an accuracy better than is required in textile work. By constructing a humidity box similar to the one described, the laboratory without a conditioning room may carry out tests under conditions of controlled humidity.

References

1 Wilson, R. E., Ind. and Eng. Chem., 13:326 (1921).
2 Greenwalt, C. H., ibid, 17:522 (1925).
3 Matthews, J. M., "Textile Fibers," Fourth Ed., p. 953 (1924).
4 Armstead and Howland, J. Text. Inst., 14:T475 (1923).
5 Barr, G., First report of the Fabrics Co-ordinating Research Committee, London, 1925, p: 47-48
6 Paranjpe, J. Indian Inst. Sci., 2:59 (1918).

Southwick Hall

SERIES 35, NO. 3 February, 1932

Bulletin

of the

Lowell Textile Institute

LOWELL, MASS.

Issued Quarterly

1932

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under Act of Congress of July 16, 1894
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Moody Street and Colonial Avenue

Publication of this document approved by the Commission on Administration and Finance
6,600 2-32 Order 4612.

CALENDAR

1931–1932

September 10–11, Thursday–Friday	Entrance Examinations
September 14–19, Monday–Saturday	Re-examinations
September 17, Thursday, 9.00 A.M.	Registration for Freshmen
September 21, Monday	Registration for upper-class students Classes begin for Freshmen
September 22, Tuesday	Classes begin for upper-class students
October 12, Monday	Columbus Day — Holiday
November 11, Wednesday	Armistice Day — Holiday
November 24, Tuesday, 4.45 P.M.	Thanksgiving recess begins
November 30, Monday, 9.00 A.M.	Thanksgiving recess ends
December 18, Friday, 4.45 P.M.	Christmas recess begins
January 4, Monday, 9.00 A.M.	Christmas recess ends
January 18, Monday	First term examinations begin
January 29, Friday	End of first term
February 1, Monday	Second term begins
February 22, Monday	Washington's Birthday — Holiday
March 25, Friday, 4.45 P.M.	Spring recess begins
April 4, Monday, 9.00 A.M.	Spring recess ends
April 19, Tuesday	Patriots' Day — Holiday
May 23, Monday	Second term examinations begin
May 30, Monday	Memorial Day — Holiday
June 7, Tuesday	Commencement
June 9–10, Thursday–Friday	Entrance Examinations

1932–1933

September 8–9, Thursday–Friday	Entrance Examinations
September 12–17, Monday–Saturday	Re-examinations
September 15, Thursday, 9.00 A.M.	Registration for Freshmen
September 19, Monday	Registration for upper-class students Classes begin for Freshmen
September 20, Tuesday	Classes begin for upper-class students
October 12, Wednesday	Columbus Day — Holiday
November 11, Friday	Armistice Day — Holiday
November 22, Tuesday, 4.45 P.M.	Thanksgiving recess begins
November 28, Monday, 9.00 A.M.	Thanksgiving recess ends
December 20, Tuesday, 4.45 P.M.	Christmas recess begins
January 4, Wednesday, 9.00 A.M.	Christmas recess ends
January 16, Monday	First term examinations begin
January 27, Friday	End of first term
January 30, Monday	Second term begins
February 22, Wednesday	Washington's Birthday — Holiday
March 24, Friday, 4.45 P.M.	Spring recess begins
April 3, Monday, 9.00 A.M.	Spring recess ends
April 19, Wednesday	Patriots' Day — Holiday
May 22, Monday	Second term examinations begin
May 30, Tuesday	Memorial Day — Holiday
June 6, Tuesday	Commencement
June 8–9, Thursday–Friday	Entrance Examinations

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HISTORICAL SKETCH
of the
LOWELL TEXTILE INSTITUTE

By virtue of legislative acts of 1928, the Lowell Textile School became known as the Lowell Textile Institute in order to more clearly define the standing of the institution. This was the natural result of the development of the original ideas and policies of the trustees who founded the Lowell Textile School. The articles of incorporation were authorized by Chapter 475, Acts of 1895, and provided for a corporation to be known as the Trustees of the Lowell Textile School of Lowell, Massachusetts. The movement for the establishment of the school dates from June 1, 1891, but it was not opened for instruction until February 1, 1897.

In accordance with the acts of incorporation the Board of Trustees consisted of twenty permanent and self-perpetuating members, three-fourths of whom must be "actively engaged in, or connected with, textile or kindred manufactures." In addition, his Honor the Lieutenant-Governor, the Commissioner of Education of the State, the mayor, the president of the municipal council, the superintendent of schools of Lowell, and a representative of the textile council were members *ec-officio*. Legislative acts of 1905 and 1906 authorized the graduates of the school to elect four trustees serving for periods of four years each.

By virtue of the anti-aid amendment to the State Constitution, and by Chapter 274, General Acts of 1918, the property of the school was transferred on July 1, 1918, to the Commonwealth of Massachusetts, and the control and management of the school was vested in a Board of Trustees appointed by the Governor, "with all the powers, rights and privileges and subject to all the duties" of the original Board.

In locating the Institute at Lowell, which has been called the "Mother Textile City of America," considerable advantage is secured by close association with every branch of the industry, which utilizes almost every commercial fiber in the products of the great Merrimack Valley textile district.

Although the school was formally opened by Governor Roger Wolcott on January 30, 1897, in rented quarters in the heart of the city, it was not until January, 1903, that the first buildings of the present plant were ready for occupancy. On February 12, 1903, Governor John L. Bates dedicated the present buildings.

PURPOSE AND SCOPE OF THE INSTITUTE

The object of the establishment of the Institute as set forth in the original act was "for the purpose of instruction in the theory and practical art of textile and kindred branches of industry."

The plan was occasioned by the apparent crisis in the leading industry of New England, due to the rapid development of the manufacture of the coarser cotton fabrics in the southern States. It was believed that this crisis could be met only by a wider and more thorough application of the sciences and arts in the production of finer and more varied fabrics.

Following the general methods and systems found successful at the higher polytechnic institutes, it offers thorough instruction in the principles of the sciences and arts applicable to textile and kindred branches of industry. The courses treat not only of the theory but also the application of these principles in the processes, on the machines and throughout all departments of industry involved in the successful manufacture, application and distribution of textile material in any form.

Though from the first the management has kept in view the clearly defined objective which called for the establishment of the Institute, it has developed its curriculum, its methods of instruction, and equipment as the needs of the industry arose. This objective will be kept constantly in view, and as new demands are presented an effort will be made to extend courses, equipment and floor space. The mechanical equipment of the Institute includes the best makes of textile machinery, and these machines, while built as they would be for regular work, are, as far as possible, adapted to the experimental work which is of particular value in such an institution as this.

Because of the breadth, grade and character of instruction given, and because of the standing and personnel of the instructing staff, the Institute has been placed by both Federal and State educational boards in the class of the higher technological schools of this country.

The United States Civil Service Commission recognizes graduates from the degree courses of this school as proper applicants for the examination to the various positions requiring a knowledge of applied science and engineering, as well as a knowledge of textile manufacturing, in the different departments of the government.

The day classes have been organized for those who can devote their entire time for three or more years to the instruction requisite in preparing to enter the textile industries. It has been found necessary to require of all such students educational qualifications equivalent to those given by a regular four-year course of a high school or academy of good standing.

The evening classes are held for about twenty weeks of the year, and are for those who are unable to attend the day courses. These are similar to the day courses, but are aimed especially to meet the needs of students working during the day in the mills and shops. For entrance to these classes an applicant should have the equivalent of a grammar school education. A detailed description of these courses and requirements is given in another Bulletin, which will be sent upon request.

BUILDINGS AND GROUNDS

The site is a commanding one, consisting of about 15 acres at a high elevation on the west bank of the Merrimack River. It extends to and overlooks the rapids of Pawtucket Falls, which was the first water power in America to be used on an extensive scale to operate power looms. It was contributed by Frederick Fanning Ayer, Esq., of New York City, and the Proprietors of the Locks and Canals on the Merrimack River.

Southwick Hall, the main building, fronting on Moody Street, was contributed by the Commonwealth of Massachusetts and Frederick Fanning Ayer, Esq., and is a memorial to Royal Southwick, a leading textile manufacturer, a public man of earlier days, and a maternal ancestor of Mr. Ayer. It includes a central mass 90 by 90 feet, having three stories and two wings 80 by 85 feet each with two stories and well-lighted basements. The building is pierced in the center by an arched way from which access is had to the wings and to the central courtyard. The northern wing is occupied by the General Offices, Engineering and Finishing Departments, and Library, while the southern wing is entirely occupied by the Chemistry and Dyeing Departments.

Kitson Hall, dedicated to the memory of Richard Kitson, was contributed by Charlotte P. Kitson and Emma K. Stott, his daughters; the Kitson Machine Company of Lowell, founded by Mr. Kitson, was also a generous contributor. This hall makes a right angle with Southwick Hall, is 70 by 183 feet, and has two stories and a basement. The first floor is occupied by the Cotton Yarn and Knitting Departments, while the basement contains the Mechanical and Electrical Engineering laboratories and the Machine Shop.

The Falmouth Street Building forms the third side of the quadrangle, and consists of three portions, one 60 by 75 feet, three stories, one 75 by 130 feet, three stories, and the head house 70 by 80 feet, three stories and basement. The building is occupied by the picker section of the Cotton Yarn Department, the Design and Power Weaving Department and by the Woolen and Worsted Yarn Department, and contains on the lower floors an equipment for the manufacture of wool yarn from the fleece to the finished yarn. The upper floors are occupied by a great variety of plain, dobby and Jacquard looms, and in a section of the building are the students' lockers and recreation rooms.

Colonial Avenue Building was erected in the summer of 1910 from plans prepared by the Engineering Department, which also had in charge the work of construction. The building completes the fourth side of the quadrangle, and in outward appearance corresponds to the architectural features of the other school buildings. It is a single-story building, and has the dimensions of 195 by 60 feet. Its interior is faced with cement brick made at the school during the progress of the

work. These serve to give light-reflecting walls which are advantageous for the work of the Wool Manufacturing, Cotton Finishing and Chemistry and Dyeing Departments that occupy this building. The funds for this building were provided by the State of Massachusetts.

The buildings are of modern mill construction adapted to educational uses and contain approximately 180,563 square feet.

CAMPUS

Through the generosity of Mr. Frederick Fanning Ayer the Institute has been provided with a campus and athletic field of about 3 acres. This has beeen carefully graded and laid out for baseball, football and track athletics.

To enclose this field the Alumni Class Fence has been partly built. It is made of forged iron sections supported between brick columns. Each section is contributed by a class, so that in the course of a few years this fence will entirely enclose the field.

On the upper floor of the Falmouth Street Building there has been provided a recreation room for the use of the students at such times as their attendance is not required in classes.

In the basement of this building there are rooms for the use of the athletic teams. Connected to these are showers and dressing rooms.

The upper hall of Southwick Hall has been equipped with gymnastic apparatus. Chest weights, wooden dumb-bells, Indian clubs, a set of traveling rings, a vaulting horse, parallel bars, a punching bag and several sets of foils and single sticks have been provided.

In order to be sure that no student having any dangerous physical weakness takes part in any athletic contest, all candidates for the various athletic teams are obliged to pass a satisfactory physical examination.

ENTRANCE REQUIREMENTS

Particular stress should be laid upon a thorough grounding in mathematics, including algebra, arithmetic and plane geometry, as these form the basis upon which the work of this school rests. While solid geometry is not required at the present time, the student will find a knowledge of this subject very valuable in his subsequent work, and is strongly recommended to include this subject as one of his electives. A preliminary course in science, including physics and chemistry, serves to prepare the student's mind for the higher branches of these subjects and their application, but neither will be considered as the equivalent of the courses in these branches given in the Institute.

Degree Courses

Candidates for admission to either of the degree courses must be graduates of a school approved by the New England College Entrance Certificate Board or by the board of Regents of New York, and must present a certificate from the principal of the school last attended, reporting upon the subjects pursued and the points obtained according to the schedule of studies given hereafter. A total of fourteen points is required.

A point represents satisfactory work in a year's study in a specified subject in an approved secondary school.

Required Subjects

Algebra A1	1
Algebra A2	1
English	4
Elementary French A (two years) or Elementary German A (two years)	2
Plane Geometry	1
History (American, Medieval and Modern, or English)	1
Physics	1
	11

Elective Subjects	Points
Chemistry	1
Elementary French (two years) or Elementary German (two years)	2
Advanced French or German (one year in addition to requirements of Elementary French A or Elementary German A)	1
History:	
American	1
Medieval and Modern	1
English	1
Latin	1
Mechanical Drawing	1
Mechanic Arts	1
Solid Geometry	1
Spanish	1
Trigonometry	1

An applicant may also be admitted on the basis of entrance examinations, in which case he must pass a sufficient number of the required subjects to make ten points and present certificates showing satisfactory courses in such of the elective subjects to make three additional points.

The objective of the elective requirements is to encourage greater breadth of preparation than that covered by the required branches. Certificates covering other subjects than those listed as elective will be entertained.

Diploma Courses

Candidates for admission to the diploma courses are accepted upon presentation of properly vouched certificates showing the completion of a regular four-year course in a high school or academy of reputable standing. The certificate must specify that the applicant has satisfactorily passed the required subjects.

A total of twelve points is required.

Required Subjects

	Points
Algebra A1	1
Algebra A2	1
English	4
Plane Geometry	1
History (American, Medieval and Modern, or English)	1
Physics	1
	9

Elective Subjects

Three may be selected from the list under Degree Courses.

ENTRANCE EXAMINATIONS

All students who are unable to present a certificate for either the degree or the diploma courses must pass entrance examinations. Notification of intention to take these examinations must be made in writing at least a week before the date of the examinations. These will be held as follows:—

Thursday, June 9, 1932; Thursday, September 8, 1932; Thursday, June 8, 1933:—
- Algebra, 9 A.M. to 11 A.M.
- History, 11 A.M. to 1 P.M.
- English, 2 P.M. to 4 P.M.

Friday, June 10, 1932; Friday, September 9, 1932; Friday, June 9, 1933:—
- Plane Geometry, 9 A.M. to 11 A.M.
- German or French, 11 A.M. to 1 P.M.
- Physics, 2 P.M. to 4 P.M.

Candidates failing to pass the June examinations are allowed to try again in September; those who cannot attend the June examinations may present themselves in September.

REQUIRED SUBJECTS FOR ENTRANCE

Algebra A1.—Derivation and use of simple formulas, graphical representation, the meaning and use of negative numbers, linear equations, with one or two unknown quantities, ratio and proportion, the essentials of algebraic technique, simple cases of exponents and radicals.

Algebra A2.—Numerical and literal quadratic equations in one unknown quantity, the binomial theorem for positive integral exponents, arithmetic and geometric series, simultaneous linear equations in three unknown quantities, simultaneous equations consisting of one quadratic and including graphical solutions, exponents and radicals.

Plane Geometry.—The usual theorems and constructions of good textbooks, including the general properties of plane rectilinear figures, the circle and the measurement of angles, similar polygons, areas, regular polygons, and the measurement of the circle. The solution of original problems and problems in mensuration of lines and plane surfaces.

English.—As secondary schools are following to a greater extent than heretofore the requirements of the College Entrance Examination Board, it is recommended that the applicant to this school conform to the suggestions of this Board relative to English composition and literature.

The examination consists of two parts, both of which are given at the same time.

(*a*) With the object of testing the student's ability to express his thoughts in writing clearly and correctly he will be required to write upon subjects familiar to him. Emphasis will be laid upon the composition, punctuation, grammar, idiom and formation of paragraphs. He will be judged by how well he writes rather than by how much he writes.

(*b*) The second part of the examination is prepared with the view of ascertaining the extent of the student's knowledge of good literature, and to test this examination questions will be based on the books adopted by the National Conference on Uniform Entrance Requirements. Any course of equivalent amount if made up of standard works will be accepted.

History.—Applicants may offer a preparation of American history, English history, or medieval and modern history.

In American history applicants should be familiar with the early settlements in America, the colonies, their government, the customs of the people, and events which led to the establishment of the United States. They should be informed concerning the causes and effects of the principal wars in which the country has been involved. They should be prepared to consider also questions requiring an elementary knowledge of civil government, as well as historical facts connected with the growth of this country up to the present time.

For the subject of English history or medieval and modern history the course given in any reputable secondary school should give proper preparation. A course extending over a full year with not less than three periods a week will be accepted.

Physics.—The applicant should be familiar with the fundamental principles of physics, particularly those considered under the headings of mechanics, heat, light, electricity and magnetism. Textbook instruction should be supplemented by lecture table experiments. Wherever possible, the student should pursue a laboratory course, but for the present no applicant will be conditioned in this subject if he has not been able to carry on a laboratory course. Where a laboratory course is offered by a secondary school, it should cover at least twenty-five of those experiments listed in the syllabus of the College Entrance Examination Board.

Modern Languages.—Required for degree courses only. It is expected that the work in these subjects has covered a period of at least two years of preparatory school training or the equivalent. Importance should be given to the ability to translate into good idiomatic English, but attention should also be paid to grammar and construction, that greater care may be used in translation.

Elementary German A.—The entrance examination is composed of two parts, both taken, however, at the same time.

(*a*) Translation of simple German prose into good idiomatic English.

(*b*) Questions to test proficiency in grammar, and simple English sentences to be rendered into German.

The requirements include the declension of articles, adjectives, pronouns and nouns; the conjugation and inflection of weak and strong verbs; the simpler uses of the subjunctive; the use of the modal auxiliaries; the prepositions and their uses; the principal parts of important verbs; and the elementary rules of syntax and word order.

Texts used in the language courses of any reputable high or preparatory school will furnish reading for translation. A list of texts is offered by the College Entrance Examination Board.

Elementary French A.—The entrance examination is composed of two parts, both taken, however, at the same time.

(*a*) Translation of simple French prose into good idiomatic English.

(*b*) Questions to test proficiency in grammar, and simple English sentences to be rendered into French.

The requirements include the principal parts, conjugation and inflection of the regular and the more common irregular verbs; the singular and plural forms of nouns and adjectives; the uses of articles and partitive construction; the forms and positions of personal pronouns; and the simpler uses of the conditional and subjunctive.

Suitable texts are suggested by the language courses of any reputable high or preparatory school and by the requirements of the College Entrance Examination Board.

Students who have pursued two years of elementary French as well as two years of elementary German may present one subject to cover two points in the required subjects, and the other to cover two points in the elective subjects.

ELECTIVE SUBJECTS

History.—If the applicant can present all three or any two branches of history specified he may include one as a required subject and the others in the list of elective subjects.

Chemistry.—Applicants must show evidence of their familiarity with the rudiments of chemistry. Any course given in a secondary school organized to present instruction by means of textbook or lecture, together with correlated laboratory work, will be considered as covering the requirements. The applicant's notebook with his original notes, including description of experiment, apparatus used, reactions, observations and deductions, must be accompanied by his instructor's certificate.

Importance will be placed upon manipulation and deductions as well as the general appearance and neatness of the notebook.

Solid Geometry.—The usual theorems and constructions of good textbooks, including the relations of planes and lines in space, the properties and measurement of prisms, pyramids, cylinders and cones; the sphere and spherical triangles. The solution of original problems and the applications of the mensuration of surfaces and solids.

Trigonometry.—The usual courses of instruction covered by the standard textbooks on plane and spherical trigonometry will prepare an applicant sufficiently to meet this requirement.

Mechanical Drawing.—The applicant must have pursued such a course in mechanical drawing that he will be familiar with the usual geometrical construction problems, projection of points, lines, planes and simple solids.

Importance is laid not only upon the accuracy with which the work is performed, but upon the general arrangement, appearance and care with which the plates are executed.

It should not be understood that work in this subject may be offered as the equivalent of the first term's work at the Institute.

Mechanics Arts.—The usual courses offered by properly equipped preparatory schools will be accepted as suitable fulfilment of this requirement. Work should include instruction in the handling of both wood and metal working tools in the more simple practices of these arts.

Elementary French B.—Applicants who enter for one of the three-year courses may present one year's work in French in a secondary school. Those who present themselves for examination in this subject should be familiar with the rudiments of grammar, and be able to translate simple French prose into good idiomatic English, also to translate into French English sentences, based on the French given for translation.

Elementary German B.—Applicants who enter for one of the three-year courses may present one year's work in German in a secondary school. What is stated in regard to French applies to those who may present German instead of French.

Advanced French or German.—In cases where applicants have pursued courses in French or German for more than two years, and have completed work which is more advanced than is included under elementary French or German, they may offer the additional year as an elective.

Spanish.—Students offering Spanish should be familiar with elementary grammar, the common irregular verbs, and be able to translate simple Spanish to English or English to Spanish. A preparation equivalent to three periods per week for two years will be acceptable.

Latin.—Students who have pursued one or more years of Latin may present this subject as an elective. Each year's work satisfactorily completed will be considered equal to one point.

ADVANCED STANDING

Candidates who may have received previous training in any of the subjects scheduled in the regular course will, upon presentation of acceptable certificates, be given credit for such work.

GRADUATE COURSES

Graduates of technical courses of other schools are invited to communicate with the president with reference to special courses in the textile studies. Previous training in the sciences and the engineering branches will usually reduce materially the time necessary to complete any of the courses at the Institute. The advantages offered to such persons for special research work are unexcelled, and a most profitable course may be arranged.

COURSES OF INSTRUCTION

Degree Courses.—The four-year degree courses are as follows:

Textile Engineering.

Chemistry and Textile Coloring.

At the completion of these courses the degrees of Bachelor of Textile Engineering (B.T.E.) and Bachelor of Textile Chemistry (B.T.C.) are conferred.

Five options are offered in the Engineering Course, viz., general textile, cotton manufacturing, wool manufacturing, design, or sales option. Each of these courses is planned to train one in the fundamental principles of science found to be applicable in the particular fields of textile chemistry and textile engineering. It is maintained that for one to be successful in either of these important branches of industry a training is required as thorough and broad as that of any of the recognized branches of engineering or of applied science.

With this in mind these courses have been built of a secure framework of science and mathematics, and to it has been added the useful application of these branches in the broad textile field. With the direct purpose of laying a secure foundation in the training, a more extended preparatory course is first demanded, and subsequently in the school work more subjects of a general character are included, that narrowness of judgment and observation may not result by overstimulation of the technical development.

Diploma Courses.—The following courses extend over a period of three years and upon the completion of any one of these the diploma of the Institute is awarded:

Cotton Manufacture.

Wool Manufacture.

Textile Design.

These are the original courses offered at the Institute, arranged to require three years' study and to give the student as thorough a training as possible for his chosen field, stressing particularly the study of textiles.

COURSES FOR WOMEN

Although all classes are open to women, the courses which have appealed especially to their tastes have been textile designing and decorative art. Some have pursued courses in chemistry, and have added to their work in design some instruction in power weaving and finishing. These special courses have in general been followed for three years, and in some cases have led the students to positions either in the mill office or in some commercial lines that have been desirable and have offered congenial work.

Within the last few years the possibilities for women in certain branches of textile chemistry have become recognized, and it is believed that in the future the positions open to them will become more and more numerous.

GENERAL INFORMATION

Application for Admission.—A blank form of application for admission may be found at the end of this bulletin. This should be properly filled out by all applicants, whether entering upon certificate from a secondary school or presenting themselves for examination.

Freshman Registration.—Each freshman is expected to be in daily attendance beginning Thursday, September 15, at 9.00 A.M., and to follow the prepared program which will be placed in his hands. A program which is planned to acquaint the new student with the institution, its location and surroundings, its courses of instruction, its recreational activities and other phases of its life is arranged for

the opening week. Unless arrangements for room and board are made previously, the first two days of the week may be used for this purpose. Physical examinations as well as certain other tests are given during this orientation period. Freshman week enables the student to secure the advantages which come from acquaintance with his surroundings, his instructors, the members of his class, student organizations, activities and customs. The overcrowding of the first week of classes with distractions is thus avoided.

Registration.—All upper classmen are required to register on or before the Monday of the week beginning the school year, and all students during the midyear examination period. For unexcused delay in registration a fee of $5 will be imposed.

Sessions.—The regular school sessions are in general from 9.00 A.M., to 12.50 P.M., and from 1.55 to 4.45 P.M., except Saturdays, when no classes are held. On Saturday afternoons the buildings are closed.

An hour plan designates the hours at which the various classes meet. This is rigidly adhered to, and the student is marked for his attendance and work as therein scheduled.

Attendance.—Attendance is required of all students on fourteen-fifteenths of all scheduled class exercises, provided they meet the requirements of their instructors for the omitted exercises. For every unexcused absence from any class exercise in excess of those allowed, a deduction from the mark obtained in the course in which the absences occurred will be made.

Advisers.—Advisers are appointed for all students, to be of such aid and assistance as they can both inside and outside of school hours. The head of the department in which a student is registered is adviser to upper-classmen, and instructors in charge of freshmen classes act as advisers to freshmen.

Conduct.—Students are required to return to the proper place all instruments or apparatus used in experimental work, and to leave clean and in working order all machinery and apparatus with which they may experiment. All breakages, accidents or irregularities of any kind must be reported immediately to the head of the department or instructor in charge.

Irregular attendance, lack of punctuality, neglect of either school or home work, disorderly or ungentlemanly conduct or general insubordination are considered good and sufficient reasons for the immediate suspension of a student, and a report to the trustees for such action as they deem necessary to take.

It is the aim of the trustees so to administer the discipline of the Institute as to maintain a high standard of integrity and a scrupulous regard for trust. The attempt of any student to present, as his own, work which he has not performed, or to pass an examination by improper means, is regarded by the trustees as a most serious offense, and renders the offender liable to immediate suspension or expulsion. The aiding or abetting of a student in any dishonesty is also held to be a grave breach of discipline.

Any student who violates these provisions will be immediately suspended by the president, and the case reported at the following meeting of the trustees for action.

Examinations.—For first-year students examinations are held every five weeks, and these serve to inform the student concerning his standing and the progress made.

For students in upper classes examinations will be held during the eighth week of each term.

Final examinations are held at the end of each term.

In general, the examinations cover the work of the preceding term, but at the discretion of the instructor may include work of earlier terms.

Examinations for students conditioned in first-term subjects are held during the second term, and examinations for students conditioned in the second-term subjects are held in September following. Students requesting condition examinations at other than scheduled dates will be required to pay $5 for each examination so taken.

Any student who fails to complete a subject satisfactorily or to clear a condition

at the time appointed, will be required to repeat the subject, and he cannot be admitted to subjects dependent thereon.

A student whose term's standing is as a whole so low that he cannot continue with profit the work of the next term will be required to leave, but he may return the following year to repeat such subjects as are required.

Daily work and regularity of attendance are considered in making up the reports of standing.

Records and Reports of Standing.—During each term informal reports are sent to parents or guardians of all students under age, and to all students; and at the end of each term formal reports are made.

The daily work of the student forms an important part of his record, and no pupil will be awarded the diploma or degree unless this portion of his record is clear.

Books are prescribed for study, for entry of lecture notes and other exercises, and are periodically examined by the lecturers. The care and accuracy with which these books are kept are considered in determining standing.

Thesis.—Each candidate for the degree of the Institute must file with the head of the department in which the thesis is taken, and not later than May 15, a report of original investigation or research, written on a good quality of paper, 8½ by 11 inches, with one-inch margin at left, and one-half inch at right, of each page; such thesis to have been previously approved by the head of the department in which it is made.

For all candidates for the diploma this requirement will be optional on the part of the Institute.

Library and Reading Room.—That the students may have surroundings conducive to reading and study a moderate-sized reading room with library tables and chairs has been provided. The library shelves contain textile, art, engineering and scientific publications. These are increased from time to time as new technical books of value to textile students are issued from the press. The leading textile papers are kept on file for ready reference.

FEES, DEPOSITS, ETC.

Tuition Fee.—The fee for the day course is $150 per year for residents of Massachusetts. For non-residents the fee for all courses is $200 per year. The fee for students from foreign countries is $300 per year.

Three-fifths of the fee is charged for a single term. Each term's tuition is payable during the first week of that term. Students failing to make this payment at the specified time will be excused from classes until satisfactory explanation and arrangements for payment can be made. *No bills will be sent.* After payment is made no fee or part thereof can be returned, except by special action of the trustees.

Special students pay, in general, the full fee, but if a course be taken involving attendance at the school during a limited time, application may be made to the president for a reduction.

Students entering from Massachusetts are required to file with the Bursar a statement signed by either town or city clerk, stating that the applicant's father is a legal resident of Massachusetts.

Athletic Fee.—An athletic fee of $15 is due and payable at the time of the first payment of tuition.

Deposits.—For all first-year students a minimum deposit of $25 is required to cover the cost of breakage, supplies, apparatus and chemicals used in the Chemical Laboratory, the unexpended balance to be returned to the student at the end of the year. For all students in second, third, and fourth years taking work in Chemistry and Dyeing Laboratories a deposit of $25 for the first term and $25 for the second term is required.

Students taking Machine Shop will be required to make deposit of $15 to cover cost of materials, supplies and breakage. Included in this charge is a kit of tools which is essential to the work and which becomes the personal property of the student. The unexpended balance will be returned at the end of the year.

Students not taking Chemistry Laboratory or Machine Shop will be required to make a deposit of $10 each year to cover general breakage. The unexpended balance will be returned at the end of the year.

All deposits must be made before students can be admitted for laboratory work.

Rooms and Board.—Students from a distance, requiring rooms and board in the city, may, if they desire, select same from a list which is kept at the Institute. The cost of rooms and board in a good district is $12 per week and upwards.

Books and Materials.—Students must provide their own books, stationery, tools, etc., and pay for any breakage or damage that they cause. The above fee includes free admission for any day students desiring to attend any of the evening classes in which there is accommodation.

Each student must provide himself with proper outer garments and wear them in such a manner when working in the various laboratories that clothing and person will be protected and not endangered by moving machinery or chemicals.

All raw stock and yarn furnished to the students, and all the productions of the Institute, remain or become its property, except by special arrangement; but each student is allowed to retain specimens of yarn or fabrics that he has produced, if mounted and tabulated in accordance with the requirements of the department. It is understood that the department may retain such specimens of students' work as they may determine.

Lockers are provided for the use of the students, sufficiently capacious to contain clothing, books and tools.

No books, instruments or other property of the Institute are loaned to the students to be removed from the premises except by special permission.

Summary of Expenses per Year

Tuition (residents of Massachusetts)	$150
Tuition (residents of other States)	200
Tuition (foreigners)	300
Chemistry laboratory deposit (1st year)	25
Chemistry laboratory deposit (2d, 3d and 4th years)	50
Athletic fee	15
Machine shop deposit	15
General breakage fee	10
(This applies to students who do not take chemistry or machine shop.)	
Books and supplies	50
(Books and supplies for the first year cost about $80, second and third year $35, and fourth year $50, thus averaging about $50 per year for the four years.)	

SCHOLARSHIPS AND PRIZES

The Massachusetts Charitable Mechanic Association Scholarship.—The Massachusetts Charitable Mechanic Association has offered six scholarships of $250 each which are for the purpose of defraying school expenses of such students as may be selected by a committee composed of a representative from the association, one from the Board of Trustees and the President of the Institute.

Louis A. Olney Book Prize.—Prizes in the form of books are awarded each year to the successful candidate on graduation day. The conditions in detail are as follows:—

First.—Ten dollars to the student taking the regular Chemistry and Textile Coloring Course who shall be considered as having attained the highest scholarship in first-year chemistry.

Second.—Five dollars to the student taking the regular Chemistry and Textile Coloring Course who shall be considered as having attained the second highest scholarship in first-year chemistry.

Third.—Ten dollars to the regular student of the Chemistry and Textile Coloring Course who shall be considered as having obtained the highest scholarship during his second year.

Fourth.—Five dollars to the regular student of the Chemistry and Textile Coloring Course who shall be considered as having attained the second highest scholarship during his second year.

Fifth.—Twenty dollars to the regular student in the Chemistry and Textile Coloring Course who shall present the best thesis preparatory to graduation.

The above-mentioned sums are to be invested in books which may be selected after graduation. In case no one is considered worthy of any particular scholarship prize, or if there is no competition, the same may be withheld. The decision in such case shall rest with the judges.

The National Association of Cotton Manufacturers Medal.—The National Association of Cotton Manufacturers offers a medal to that member of the graduating class who, during his course, shall have attained the highest standing in special subjects required by the vote of the association.

STUDENT ACTIVITIES AND ORGANIZATIONS

School Publications.—The Text is issued bi-weekly and it contains news pertaining to activities in the Institute as well as information concerning alumni. The Pickout is an annual publication in charge of a manager and editor selected from the senior class. The board is composed of representatives from the various classes.

Fraternities.—There are four fraternities, three of which are national and one is local. They afford opportunity for social life desired in a college career.

Dramatic Club.—The Dramatic Club gives annually a theatrical program at the Lowell Auditorium. Appropriation is made from the profits to the treasury of the Athletic Association.

Professional Clubs.—A Student Section of the American Society of Mechanical Engineers holds meetings regularly in accordance with requirements of the national organization. The Student Section of the American Society of Dyers and Colorists hold meetings at which papers are delivered or speakers come from outside the school organization.

Rifle Club.—The rifle club offers opportunity to all students to attain proficiency in marksmanship and selects the team for interscholastic matches with other colleges.

Honor Society.—To degree candidates who have maintained a high scholarship for three years' work, or who have met with certain similar requirements, is accorded the honor of membership in the society Tau Epsilon Sigma. Relatively a membership in this society corresponds to that in some of the well-known honor societies of the liberal arts and scientific colleges. It requires constant attendance and application to the work of the course for any student to reach the scholarship level entitling him to this membership.

Honor Roll.—The President's List includes upper classmen taking a regular course who have a general average of eighty percent and no deficiencies.

Co-operative Society.—This society is maintained for the benefit of students who desire to purchase supplies and materials for use in connection with their work. It is operated under the direction of a manager and assistant manager and one or more clerks. The general business policy is under the supervision of a member of the faculty. Students who join the society are entitled to discount privileges when purchasing from the society and from certain firms in the city of Lowell.

Alumni Association.—The Alumni Association of the Institute holds its annual meeting and banquet in May of each year.

The membership of the association is composed of graduates of the day courses and is open to any non-graduate who has attended the Institute for at least one year.

Officers for the Year 1931–32

Charles H. Forsaith, '20, *President*
Arnold J. Midwood, '05, *Vice-President*
Arthur A. Stewart, '00, *Secretary-Treasurer*

Communications should be addressed to Arthur A. Stewart, Lowell Textile Institute.

Ex-Officio Members of Executive Committee

Edward M. Abbot, '04
Henry A. Bodwell, '00
Charles W. Churchill, '06
Thomas T. Clark, '10
Frank L. McCool, '10
Stanley H. Wheelock, '05
Royal P. White, '04

Executive Committee

15 *Members*

Philip H. Warren, '05
Alexander Campbell, '23
James F. Dewey, '04
Leonard S. Farr, '08
Russell T. Fisher, '14
Olin D. Gay, '08
Brackett Parsons, '20
Everett B. Rich, '11
Richard M. Sawyer, '27
Dean W. Symmes, '22
Ernest D. Walen, '14
J. Milton Washburn, '21
A. Edwin Wells, '20
Stanley H. Wheelock, '05
Edward L. Wingate, Jr., '28

SUBJECTS OF INSTRUCTION

In the column headed "Hours of Exercise" the numbers represent for each particular subject the total hours required in school for a period of fifteen weeks.

The letter and number which follow the subjects indicate the department in which the subject is given and the number of the subject in that department. For detailed description of the same, see page 34.

The departments are indicated as follows:—

Textile Engineering	B	Cotton Yarns	F
Chemistry and Textile Coloring	C	Woolen and Worsted Yarns	G
Textile Design and Power Weaving	D	Finishing	H
Languages and History	E		

By referring to the letter and number indicated under "Preparation" the student can ascertain what subjects are necessary in order that he may have a clear understanding of the subject which he is scheduled to take.

First Year

First Term

(Common to all Courses)

	Hours of Exercise
Elementary Chemistry C–10	105
English E–10	45
Mathematics B–10	45
Mechanical Drawing B–13	135
Physics B–11	75
Physical Education	30
Textile Design and Cloth Analysis D–10	75

Second Term

	Course IV	Course VI
Elementary Chemistry C–10	120	120
Elementary German E–11	30	–
English E–10	45	45
Machine Drawing B–14 or B–14a	45	120
Mathematics B–10	60	60
Mechanism B–12	60	60
Physical Education	30	30
Qualitative Analysis C–11	135	–
Textile Design and Cloth Analysis D–10	–	90

For second-term subjects in Courses I, II, and III, see pages 21, 23, 25.

Course I.—Cotton Manufacture

The Cotton Manufacturing Course is designed for students contemplating a career in the manufacturing of cotton yarns, cloth or allied industries, and wishing to devote but three years to instruction at the Institute.

During the first term the studies are common to all courses, and include instruction in mathematics, mechanical drawing, physics, textile design and elementary chemistry.

During the second term, lectures in organic chemistry are given followed by lectures in textile chemistry and dyeing the second year. The work in mechanism serves as a basis for all future machine and mechanical work, and is followed by steam engineering, electricity and mill engineering. The course in textile designing, cloth analysis and cloth construction includes lectures on plain, fancy and Jacquard weaves, the analysis of all commercial fabrics, and designs for the same.

Power weaving is taken up during the second and third years. Commencing with lectures and practice upon plain looms, the instruction continues with dobby, box-loom, and Jacquard weaving.

A course in knitting taken during the third year includes the manufacture of flat goods, hosiery and underwear. Considerable laboratory practice accompanies the lecture work, giving the students actual working knowledge of a wide range of knitting machines. Instruction in the finishing of cotton fabrics is given by lectures and laboratory work, and requires considerable work on standard machines in the laboratory. Textile testing, also given in the third year, instructs the student in standard methods for physical testing of textile material.

The course in Cotton Carding is given in the second year. The instruction covers the production of cotton throughout the world, the classing of various cottons and the various methods of marketing the cotton crop. Particular emphasis is given to the American cotton crop. The treatment of cotton in the mill processes covers all the operations preparatory to spinning, for the regular cotton system and for the cotton waste systems. Opening, picking, carding, combing, drawing and roving are the operations included. Lectures supplement the material available in text books in order to have the course up to date. Considerable time is spent in the laboratory studying cotton fibers, classing, processing stock and making various tests on the adjustment of machines and the effect on the quality of the work produced.

The third year's work continues that of the second year, with detailed study of spinning, spooling, twisting and winding. Another course gives instruction in mill organization, balancing and arranging machinery in the mill. Finally, a brief course is given in the use of the microscope and camera in studying various problems in cotton manufacture. Laboratory practice supplements the lecture course, giving practical operation, adjustment and observation of the machines studied. Advanced laboratory work illustrates the methods of study and analysis of the more general and complex problems such as are usually handled in the laboratory of a textile plant.

During both the second and third years, particular attention is given to the preparation of the various reports in order that the student may learn proper methods for presenting data and conclusions resulting from mill studies and tests.

During the third year, each student makes some original study, usually of a technical nature. He must make a formal report ot this study satisfactory to the faculty before receiving his diploma.

For detailed description of the subjects see page 34.

Course I.—Cotton Manufacture

[For first term see page 19]

First Year. Second Term. (Hours of Exercise)

Elementary Chemistry C-10	120	Mechanism B-12	60
English E-10	45	Physical Education	30
Machine Drawing B-14	120	Textile Design and Cloth Analysis D-10	90
Mathematics B-10	60		

Second Year. First Term

Cotton Yarn Manufacture F-20	270	Textile Chemistry and Dyeing Lect. C-21	30
Physics B-22a	45	Textile Design and Cloth Construction D-20	75
Power Weaving D-23	75		
Steam Engineering B-24	30		

Second Year. Second Term

Cotton Yarn Manufacture F-20	240	Textile Design and Cloth Construction D-20	60
Physics B-22a	45		
Power Weaving D-23	180		

Third Year. First Term

Cotton Finishing H-31	75	Mill Engineering B-34a	30
Cotton Organization F-32	60	Power Weaving D-32	135
Cotton Yarn Manufacture F-30	165	Textile Testing G-31	30
Electricity B-31a	30	Thesis F-34.	

Third Year. Second Term

Cotton Finishing H-31	75	Power Weaving D-32	120
Cotton Yarn Manufacture F-30	210	Thesis F-34.	
Knitting F-31	120		

Course II.—Wool Manufacture

The course on wool manufacturing is arranged for those who contemplate a career in the manufacture of woolen or worsted fabrics, and can devote but three years to the school work. It includes instruction on all of the varied processes employed in manipulating the wool fiber to produce yarn and cloth, namely, sorting, scouring, carding, combing, spinning, designing, weaving, dyeing and finishing. The work is carried on by lectures, recitations and practical work in the laboratories.

Beginning with the second year the details of manipulating wool from the grease to the finished yarn is taken up for close study. This includes the spinning of woolen yarn, also worsted yarn, by both the English and the French systems. The intermediate processes of sorting, scouring, carding, combing and top-manufacturing are taken in detail and in proper sequence.

The general chemistry of the first year is followed by a lecture course in the second year on textile chemistry and dyeing.

Textile design, cloth analysis and construction are continued from the first year throughout the course, the work being applied especially to woolen and worsted goods. Weaving on power looms commences in the second year and continues through the third.

A course in knitting taken during the third year includes the manufacture of flat goods, hosiery and underwear. Considerable laboratory practice accompanies the lecture work, giving the students actual working knowledge of a wide range of knitting machines.

Lectures on finishing commence with the third year and are augmented by extensive practice with the machines in the Finishing Department.

Work in the Engineering Department extends throughout all three years, and includes mechanical drawing, steam engineering and electricity. The practical application of the principles studied in these subjects is brought out forcibly in the work on mill engineering, where mill design and construction are considered. A short course covering methods employed in the testing of fibers, yarns, and cloths, together with laboratory work in the manipulation of certain physical apparatus, is given in the third year.

For detailed description of the subjects see page 34.

Course II.—Wool Manufacture

[For first term see page 19]

First Year. Second Term. (Hours of Exercise)

Elementary Chemistry C–10	120	Mechanism B–12	60
English E–10	45	Physical Education	30
Machine Drawing B–14	120	Textile Design and Cloth Analysis D–10	90
Mathematics B–10	60		

Second Year. First Term

Fibre Preparation G–20–21	255	Textile Design and Cloth Construction D–21	75
Physics B–22a	45	Textile Chemistry and Dyeing Lect. C–21	30
Power Weaving D–23	90		
Steam Engineering B–24	30		

Second Year. Second Term

Fibre Preparation G–20–21	270	Textile Design and Cloth Construction D–21	75
Physics B–22a	45		
Power Weaving D–23	135		

Third Year. First Term

Electricity B–31a	30	Power Weaving D–32	135
Finishing H–30	75	Textile Testing G–31	30
Mill Engineering B–34a	30	Worsted Yarn Manufacture G–30	225

Third Year. Second Term

Finishing H–30	75	Worsted Yarn Manufacture G–30	225
Knitting F–31	120	Thesis.	
Power Weaving D–32	105		

Course III.—Textile Design

The general course in textile design is planned to meet the demand of young men for a technical training in the general processes of textile manufacturing, but with particular reference to the design and construction of fabrics. To this end a foundation is laid in the first year by instruction in the elementary principles of designing, decorative art and weaving. That he may later in the course pursue to advantage instruction in yarn manufacturing, weaving, dyeing, finishing and some engineering problems, a foundation course in mechanics, mathematics and chemistry is laid. As the student is required to pursue courses in the yarn departments, both cotton and wool, he acquires a knowledge of the manufacture of cotton yarns from the bale to the yarn, and of woolen and worsted yarns from the fleece through the varied processes of manufacturing woolen yarn or worsted yarn by both the French and Bradford systems.

Throughout his entire course he receives instruction in design, cloth analysis and construction of all the standard cloths, viz., trouserings, coatings, suitings, blankets, velvets, corduroys, plushes, etc. This is followed by advanced work in Jacquard designing and weaving, which serves not only to acquaint the student with the many kinds of cotton, woolen, worsted and silk fabrics of figured design, but stimulates and develops any artistic talent he may possess. Decorative art becomes an important part of the work of the second and third years.

The course in general inorganic and organic chemistry of the first year leads to the subject of textile chemistry and dyeing in the second year.

Power weaving commences with the second year and continues throughout the course, and work on all types of looms is required.

During the third year the student receives instruction in the finishing of cotton goods and woolen and worsted cloths. This instruction is given by means of lecture and laboratory work.

The engineering subjects given in the second and third years are intended to acquaint the student with such general knowledge as will be of assistance should he be called upon in later life to be a mill manager, or should his subsequent progress lead to some executive position in the operation of a textile plant.

For detailed description of the subjects see page 34.

Course III.—Textile Design

[For first term see page 19]

First Year. Second Term. (Hours of Exercise)

Elementary Chemistry C–10	120	Mechanism B–12	60
English E–10	45	Physical Education	30
Machine Drawing B–14	120	Textile Design and Cloth Analysis D–10	90
Mathematics B–10	60		

Second Year. First Term

Cotton Yarn Manufacture F–20a	90	Textile Chemistry and Dyeing Lect. C–21	30
Physics B–22a	45	Textile Design and Cloth Construction D–20, 21	240
Power Weaving D–23	75		
Steam Engineering B–24	30		

Second Year. Second Term

Cotton Yarn Manufacture F–20a	45	Power Weaving D–23	120
Fibre Preparation G–20–21	90	Textile Design and Cloth Construction D–20, 21	135
Jacquard Design D–22	90		
Physics B–22a	45		

Third Year. First Term

Cotton Finishing H–31	75	Textile Testing G–31	30
Electricity B–31a	30	Woolen and Worsted Finishing H–30	75
Mill Engineering B–34a	30	Worsted Yarn Manufacture G–30	90
Power Weaving D–32	60		
Textile Design and Cloth Construction D–30	135		

Third Year. Second Term

Cotton Finishing H–31	75	Woolen and Worsted Finishing H–30	75
Jacquard Design D–31	90	Worsted Yarn Manufacture G–30	60
Power Weaving D–32	135	Thesis.	
Textile Design and Cloth Construction D–30	90		

Course IV.—Chemistry and Textile Coloring

The four-year course in Chemistry and Textile Coloring, leading to the degree of B.T.C., is especially intended for those who wish to engage in any branch of textile chemistry, textile coloring, bleaching, finishing or the manufacture and sale of the dyestuffs or chemicals used in the textile industry. The theory and practice of all branches of dyeing, printing, bleaching, scouring and finishing are taught by lecture work supplemented by a large amount of experimental laboratory work and actual practice in the dyehouse and finishing room.

The underlying theories and principles of chemistry are the same, no matter to what industry the application is eventually made. Furthermore, no industry involves more advanced and varied applications of the science of chemistry than those of the manufacture and application of the coal-tar coloring matters. In addition, the textile colorist must consider the complex composition of the textile fibers, and the obscure reactions which take place between them and the other materials of the textile industry.

During the first year general chemistry, including both inorganic and organic, is taught by lectures and laboratory work, and this is supplemented during the second term by qualitative analysis and stoichiometry.

Advanced inorganic chemistry, as well as advanced organic chemistry, is studied during the second and third year as a continuation of the elementary chemistry of the first year, and much time is spent upon quantitative analysis, industrial chemistry, and textile chemistry and dyeing.

The foundation work in general chemistry is continued during the third year with courses in physical chemistry, organic laboratory work and analytical work. The subject of industrial chemistry is introduced, and much time is devoted to advanced textile chemistry, dye testing, color matching, calico printing, and woolen, worsted and cotton finishing.

The fourth year is characterized by an endeavor to present certain subjects of a more applied nature in such a manner that the student's reasoning power and ability to apply the knowledge gained during the first three years may be developed to the fullest extent. The subject of engineering chemistry is introduced, and the work in the Dyeing and Analytical Laboratories is applied as far as possible to the actual requirements of the factory chemist and colorist. Much time is also spent in the Organic Chemistry laboratory, particular attention being given to the preparation of typical dyestuffs. Thorough courses are given in microscopy, photomicrography and the use of various instruments such as the spectroscope, ultra-microscope, polariscope, tintometer and other optical instruments applicable to experimental work in connection with the textile industry. Courses are also given in Report Writing and Textile Literature.

During this fourth year the student has an opportunity to take several optional subjects of an advanced nature and conduct such research work and original investigation as time may permit.

For detailed description of the subjects see page 34.

Course IV.—Chemistry and Textile Coloring

[For first year see page 19]

Second Year. First Term. (Hours of Exercise)

Advanced German E–21	30	Quantitative Analysis C–23	150
Adv. Organic Chemistry C–22	30	Stoichiometry C–24	15
English E–20	30	Textile Chemistry and Dyeing Lab. C–21	90
Mathematics B–20a	45	Textile Chemistry and Dyeing Lect. C–20	45
Physics B–22a	60		
Power Weaving D–23	15		

Second Year. Second Term

Advanced German E–21	30	Stoichiometry C–24	15
Adv. Organic Chemistry C–22	30	Textile Chemistry and Dyeing Lab. C–21	120
English E–20	30	Textile Chemistry and Dyeing Lect. C–20	45
Mathematics B–20a	45		
Physics B–22a	60		
Quantitative Analysis C–23	135		

Third Year. First Term

Adv. Organic Chemistry Lect. C–34	30	Economics E–30	45
Adv. Textile Chemistry and Dyeing Lab. C–32	135	Physical Chemistry C–33	45
Adv. Textile Chemistry and Dyeing Lect. C–32	30	Quantitative Analysis C–30	135
		Technical German C–35	30
		Woolen and Worsted Finishing H–30	75

Third Year. Second Term

Adv. Textile Chemistry and Dyeing Lab. C–32	75	Physical Chemistry C–33	45
Adv. Textile Chemistry and Dyeing Lect. C–32	15	Photography C–37	15
Economics E–30	45	Quantitative Analysis C–30	105
Industrial Chemistry C–31	30	Technical German C–35	30
Organic Laboratory C–36	90	Woolen and Worsted Finishing H–30	75

Fourth Year. First Term

Adv. Textile Chemistry and Dyeing Lab. C–44	90	Options or Thesis C–52	90
Adv. Textile Chemistry and Dyeing Lect. C–44	30	Organic Laboratory C–41	75
Chemical Textile Testing C–43	45	Physical Chemistry C–42	45
Microscopy and Photomicroscopy C–45	60	Quantitative Analysis C–46	15
		Report Writing C–47	15
		Technical German C–40	30
		Textile Marketing B–44	30

Fourth Year. Second Term

Advanced General Chemistry C–49	30	Engineering Chemistry C–50	45
Adv. Textile Chemistry and Dyeing Lab. C–44	90	Options or Thesis C–52	90
Adv. Textile Chemistry and Dyeing Lect. C–44	15	Organic Laboratory C–41	105
Chemical Textile Testing C–43	45	Rayon Manufacturing C–51	30
		Technical German C–40	30
		Textile Literature C–48	15

Course VI.—Textile Engineering

This course is the four-year general textile course leading to the degree of Bachelor of Textile Engineering (B.T.E.), and aims especially to fit men, in the broadest possible manner, to meet the increasing demands of every branch of the textile industry for men with combined textile and technical preparation. The magnitude and scope of the textile and allied industries fully justify the most thorough technical training possible for all who aspire to leadership in this field.

The student is first thoroughly grounded in those fundamental principles of science upon which all industrial and engineering work rests. The foundation of his textile and technical training is in the subjects of mathematics, physics, chemistry, drawing, mechanics, mechanism, and technology of fibres, and their practical application.

Instruction is given in all the various branches of textile manufacturing through lectures, recitations and laboratory work. A large proportion of his time is spent in well-equipped textile departments where he studies and operates all of the machinery required in the conversion of cotton and wool fiber into yarns and fabrics. This includes cotton, wool and worsted yarn manufacturing, designing, weaving, knitting, dyeing and finishing. In his last year the course in textile testing acquaints the student with the methods for determining the physical properties of textile fibers, yarns and fabrics.

To properly equip the student to meet the varied engineering problems which confront the mill manager or executive, or to so train him that he may enter those industries closely allied to the textile, instruction is given by lecture and laboratory practice in the several branches of engineering.

Steam engineering considers the problems involved in steam generation and distribution for power, heating and manufacturing purposes, and includes the testing of laboratory and power plant equipment. The course in electrical engineering treats of the generation and transmission of electrical power, the testing of direct and alternating current machinery, and is intended to acquaint the student with modern practice.

Mill engineering familiarizes the student with mill design, construction, heating, lighting, humidification and fire protection. The arrangement of machinery and buildings for most efficient production and economical power distribution is also studied in detail.

The broadening effect of such subjects as English and economics is carried still further in this course by carefully planned courses in business administration, accounting, cost accounting and business law.

During the fourth year the student is required to conduct an original investigation of some textile or allied problem, and to submit the results in the form of a satisfactory thesis before receiving his degree.

For the student who may desire the breadth of technical training which this course offers, but who wishes to specialize in either cotton or wool manufacturing, two options are offered. In these optional courses the student's entire textile time is devoted to the study of that particular fiber which he elects. Provision is also made for the substitution of knitting for weaving laboratory time in the case of those who prefer to lay more emphasis on knit fabrics.

During the past few years a demand has come from the distributing or marketing branches of the textile business for men with a four years' technical training. With the idea of offering courses which may better prepare graduates to meet this new call, the new Sales Option Course is offered.

There are also requests for a four-year Design Course which, while majoring in Textile Design, includes other subjects that help to make a broader course than the one of three years' duration. For this purpose the Design Option Course is offered. Like the other courses outlined, these will be subject to changes to meet new demands.

For detailed description of subjects, see page 34.

Course VI.—Textile Engineering (General Course-G)

[For first year see page 19]

Second Year. First Term. (Hours of Exercise)

Cotton Yarn Manufacture F–20a	60	Physics B–22	75
Fibre Preparation G–20, 21	120	Textile Chemistry and Dyeing Lecture C–21	30
Machine Drawing B–21	60	Textile Design and Cloth Constructive D–20, 21	45
Machine Shop B–23	75		
Mathematics B–20	60		

Second Year. Second Term

Fibre Preparation G–20, 21	90	Machine Drawing B–21	60
Advanced Textile Mechanism B–26,	45	Mathematics B–20	60
Applied Mechanics B–25	45	Physics B–22	75
Cotton Yarn Manufacture F–20a	60	Power Weaving D–23	90

Third Year. First Term

Applied Mechanics B–30	45	Power Weaving D–32	60
Cotton Yarn Manufacture F–30a	60	Worsted Yarn Manufacture G–30	90
Economics E–30	45	Woolen and Worsted Finishing H–30	75
Electrical Engineering B–31	75		
Heat Engineering B–32	75		

Third Year. Second Term

Cotton Yarn Manufacture F–30a	60	Mill Engineering B–34	90
Economics E–30	45	Worsted Yarn Manufacture G–30	90
Electrical Engineering B–31	75	Woolen and Worsted Finishing H–30	75
Heat Engineering B–33	90		

Fourth Year. First Term

Accounting B–40	90	Mill Engineering B–45	75
Cotton Organization F–32	90	Textile Marketing B–42	30
Electives B–48		Textile Testing B–43	30
Electrical Engineering B–44	75	Thesis	75
Microscopy B–41	45		

Fourth Year. Second Term

Business Administration B–46	90	Mill Engineering B–45	75
Cotton Finishing H–31	105	Mill Illumination B–47	45
Electives B–48		Textile Testing B–43	15
Electrical Engineering B–44	75	Thesis	90
Knitting F–31a	30		

Course VI.—Textile Engineering (Cotton Option-C)

[For first year see page 19]

Second Year. First Term. (Hours of Exercise)

Cotton Yarn Manufacture F-20a	210
Machine Drawing B-21	90
Machine Shop B-23	45
Mathematics B-20	60
Physics B-22	75
Textile Chemistry and Dyeing Lecture C-21	30
Textile Design and Cloth Construction D-20	15

Second Year. Second Term

Advanced Textile Mechanism B-26	45
Applied Mechanics B-25	45
Cotton Yarn Manufacture F-20a	165
Mathematics B-20	60
Physics B-22	75
Power Weaving D-23	135

Third Year. First Term

Applied Mechanics B-30	45
Cotton Finishing H-31	75
Cotton Yarn Manufacture F-30a	120
Economics E-30	45
Electrical Engineering B-31	75
Heat Engineering B-32	75
Power Weaving D-32	45
Textile Design and Cloth Construction D-20	45

Third Year. Second Term

Cotton Finishing H-31	75
Cotton Yarn Manufacture F-30a	120
Economics E-30	45
Electrical Engineering B-31	75
Heat Engineering B-33	90
Mill Engineering B-34	90
Textile Design and Cloth Construction D-20	30

Fourth Year. First Term

Accounting B-40	90
Cotton Organization F-32	105
Electives B-48	
Electrical Engineering B-44	75
Microscopy B-41	45
Mill Engineering B-45	30
Textile Design and Cloth Construction D-30	30
Textile Marketing B-42	30
Textile Testing B-43	30
Thesis	75

Fourth Year. Second Term

Business Administration B-46	90
Electives B-48	
Electrical Engineering B-44	75
Knitting F-31a	120
Mill Engineering B-45	30
Mill Illumination B-47	45
Textile Design and Cloth Construction D-30	45
Textile Testing B-43	15
Thesis	105

Course VI.—Textile Engineering (Wool Option-W)

[For first year see page 19]

Second Year. First Term. (Hours of Exercise)

Fibre Preparation G–20, 21	210	Textile Chemistry and Dyeing Lecture C–21	30
Machine Drawing B–21	90	Textile Design and Cloth Construction D–21	15
Machine Shop B–23	45		
Mathematics B–20	60		
Physics B–22	75		

Second Year. Second Term

Advanced Textile Mechanism B–26	45	Mathematics B–20	60
Applied Mechanics B–25	45	Physics B–22	75
Fibre Preparation G–20, 21	180	Power Weaving D–23	120

Third Year. First Term

Applied Mechanics B–30	45	Power Weaving D–32	60
Economics E–30	45	Worsted Yarn Manufacture G–30	150
Electrical Engineering B–31	75	Woolen and Worsted Finishing H–30	75
Heat Engineering B–32	75		

Third Year. Second Term

Economics E–30	45	Worsted Yarn Manufacture G–30	150
Electrical Engineering B–31	75	Woolen and Worsted Finishing H–30	75
Heat Engineering B–33	90		
Mill Engineering B–34	90		

Fourth Year. First Term

Accounting B–40	90	Textile Design and Cloth Construction D–30	75
Electives B–48		Textile Marketing B–42	30
Electrical Engineering B–44	75	Textile Testing B–43	30
Microscopy B–41	45	Thesis	135
Mill Engineering B–45	30		

Fourth Year. Second Term

Business Administration B–46	90	Mill Illumination B–47	45
Electives B–48		Textile Design and Cloth Construction D–30	75
Electrical Engineering B–44	75	Textile Testing B–43	15
Knitting F–31a	30	Thesis	165
Mill Engineering B–45	30		

Course VI.—Textile Engineering (Design Option-D)

[For first year see page 19]

Second Year. First Term. (Hours of Exercise)

Cotton Yarn Manufacture F–20a	90	Textile Chemistry and Dyeing Lecture C–21	30
Fibre Preparation G–20, 21	45	Textile Design and Cloth Construction D–20, 21	225
Mathematics B–20	60		
Physics B–22	75		

Second Year. Second Term

Advanced Textile Mechanism B–26	45	Physics B–22	75
Cotton Yarn Manufacture F–20a	60	Power Weaving D–23	90
Fibre Preparation G–20, 21	90	Textile Design and Cloth Construction D–20, 21	105
Mathematics B–20	60		

Third Year. First Term

Cotton Yarn Manufacture F–30a	60	Worsted Yarn Manufacture G–30	90
Economics E–30	45	Woolen and Worsted Finishing H–30	75
Power Weaving D–32	75		
Textile Design and Cloth Construction D–30	180		

Third Year. Second Term

Cotton Yarn Manufacture F–30a	60	Textile Physics B–37	75
Economics E–30	45	Worsted Yarn Manufacture G–30	90
Power Weaving D–32	90	Woolen and Worsted Finishing H–30	75
Textile Design and Cloth Construction D–30	90		

Fourth Year. First Term

Accounting B–40	90	Textile Marketing B–42	30
Jacquard Weaving	90	Textile Styling and Merchandising B–50	75
Microscopy B–41	45	Textile Testing B-43	30
Textile Design and Cloth Construction	75	Thesis	90

Fourth Year. Second Term

Business Administration B–46	90	Textile Testing B–43	15
Cotton Finishing H-31	105	Thesis	75
Power Weaving	75		
Textile Design and Cloth Construction	165		

Course VI.—Textile Engineering (Sales Option-S)

[For first year see page 19]

Second Year. First Term. (Hours of Exercise)

Cotton Yarn Manufacture F-20a	90	Textile Chemistry and Dyeing Lecture C-21	30
Fibre Preparation G-20, 21	45	Textile Design and Cloth Construction D-20, 21	225
Mathematics B-20	60		
Physics B-22	75		

Second Year. Second Term

Advanced Textile Mechanism B-26	45	Physics B-22	75
Cotton Yarn Manufacture F-20a	60	Power Weaving D-23	90
Fibre Preparation G-20, 21	90	Textile Design and Cloth Construction D-20, 21	105
Mathematics B-20	60		

Third Year. First Term

Cotton Yarn Manufacture F-30a	60	Worsted Yarn Manufacture G-30	90
Economics E-30	45	Woolen and Worsted Finishing H-30	75
Power Weaving D-32	90		
Principles of Marketing B-35	45		
Textile Design and Cloth Construction D-30	120		

Third Year. Second Term

Cotton Yarn Manufacture F-30a	60	Textile Physics B-37	75
Economics E-30	45	Worsted Yarn Manufacture G-30	90
Marketing Methods B-36	90	Woolen and Worsted Finishing H-30	75
Textile Design and Cloth Construction D-30	90		

Fourth Year. First Term

Accounting B-40	90	Textile Styling and Merchandising B-50	75
Jacquard Weaving	90	Textile Testing B-43	30
Microscopy B-41	45	Thesis	90
Principles of Selling and Advertising B-49	105		

Fourth Year. Second Term

Business Administration B-46	90	Selling Policies B-52	45
Cotton Finishing H-31	105	Statistics	45
Foreign Trade and Economic Geography B-51	45	Textile Testing B-43	15
Knitting F-31a	75	Thesis	105

SUBJECTS OF INSTRUCTION

TEXTILE ENGINEERING DEPARTMENT—B

The various options are designated by G, C, W, D, S.

Mathematics—B-10. Preparation: Admission Requirements. The work in the first term consists of algebra, plane trigonometry, and instruction in the use of the slide-rule. Algebra is reviewed through quadratics and then logarithms are taken. In plane trigonometry, right and oblique triangles are solved by means of natural and logarithmic functions, and the various algebraic relations among the trigonometric functions are proved and used in identities and equations. Significant figures and the use of approximate data in calculations are also discussed.

In the second term the following topics are taken up: graphical and mathematical solution of quadratic and simultaneous equations, theory of equations, partial fractions, Naperian logarithms, equations of the straight line, equations of various curves, differentiation of algebraic functions, and applications of the derivative. [All courses.]

Physics—B-11. Preparation: Admission Requirements. Taken simultaneously with B-10. This subject is required as a necessary preparation for all courses, and is given during the first term of the first year. The fundamental principles of this subject are considered absolutely essential to a thorough understanding of the operation of all machinery, textile or otherwise. Some of the topics treated in this course are linear and angular velocity, uniform and accelerated motion, mass, momentum, inertia, effect of force in producing motion, centrifugal force, work, power, energy, principle of moments and its applications, parallelogram and triangle of forces with applications, resolution and composition of forces, the mechanical principles represented by the wheel and axle, differential pulley block, common pulley blocks, jackscrew, worm and wheel, and inclined plane.

Laboratory. This course is supplementary to the lecture course and gives the student an opportunity to apply the knowledge gained in the lecture course by performing various experiments. [All courses.]

Mechanism—B-12. Preparation: B-10 and B-11. This subject is also deemed to be one of those absolutely essential to every student's preparation for the work of the following years. Whereas the principles studied are of general application, textile machinery in particular furnishes an unusually large variety of specific examples, and frequent reference is made to these in the development of the course. Some of the important topics covered are gearing and gear train design, belting and pulley calculations, cone and stepped pulley design, cam design, linkages, epicyclic gear trains, and intermittent motion devices.

Mechanical Drawing—B-13. Preparation: Admission Requirements. Taken simultaneously with B-11. This course is taken during the first year, and consists of work in the drawing room supplemented by lectures. This subject is considered of the greatest importance as a preparation for the student's future work, and the practical usefulness of drawing of this character is fully emphasized. The course is systematically laid out covering in order the following divisions:—

Care and use of drawing instruments; geometrical constructions; lettering; elements of projections and descriptive geometry; isometric projection; developments with practical applications; sketching practice on machine details. [All courses.]

Machine Drawing—B-14. Preparation: B-13. This course is the continuation of Mechanical Drawing, and is pursued throughout the second term of the first year. The work is wholly of a practical character, and includes sketching from the textile machinery details and working scale details, tracing and blue-printing. The rudiments of machine design to supplement the work in strength of materials are also given. [Courses I, II, III, VI.]

Machine Drawing—B-14a. Preparation: B-13. This course is similar to B-14, but not so extensive, and is given to students electing the Chemistry and Textile Coloring course. [Course IV.]

Mathematics—B-20. Preparation: B-10. This subject is a continuation of the first year subject B-10, and extends throughout the second year of the engi-

neering course. In the first term the following topics are treated:—derivatives and differentials, the circle, parabola, ellipse, hyperbola, indefinite integrals, summation by integration and applications of integration. In the second term the topics are: differentiation of transcendental functions, methods of integration, centers of gravity, moments of inertia, empirical formulas, and nomographic charts. [Course VI.]

Mathematics—B-20a. Preparation: B-10. This subject is a continuation of the work of the first-year subject B-10. A study of the derivative is followed by the differentiation of algebraic functions and applications of the derivative to maximum and minimum and rate problems. Other topics treated are the circle, parabola, ellipse, hyperbola, indefinite integrals, summation by integration, areas, volumes and pressures. [Course IV.]

Machine Drawing—B-21. Preparation: B-13. The work in Machine Drawing is devoted to working detail drawings of textile machinery and advanced graphical mechanism problems. The data for all of these problems are in every case taken directly from some of the textile machines that the students meet in other departments. [Course VI, Options G, C, W.]

Physics—B-22. Preparation: B-10 and B-11. This subject lays the foundation for later work in engineering and chemistry and also explains the general application of the laws and principles of physics. Instruction, consisting of lectures, demonstrations, and recitations, is given for three hours per week during the second year. The topics taken up the first term are:—thermometry, measurement of heat, change of state, expansion, transfer of heat, humidity, hydrostatics, elements of hydraulics, the vernier, kinetic energy, circular motion, harmonic motion, wave motion and sound.

The second term is devoted to the study of light, magnetism, and electricity. Some of the topics are:—nature and propagation of light, reflection and refraction lenses, the telescope and microscope, the spectroscope, color sensation, double refraction, magnetism, electrostatics, fundamental laws of direct currents and electrolysis.

Laboratory. A two-hour period per week accompanies the class work in this subject and is planned to illustrate precise methods for measuring various physical quantities. [Course VI.]

Physics—B-22a. Preparation: B-10a and B-11. This subject consists of the same topics as B-22 but does not contain any laboratory work. [Courses I, II, III, IV.]

Machine Shop Practice—B-23. Preparation: B-11 and B-12. Systematic instruction is given in the most approved methods of machine shop practice, the object being to familiarize the student with the proper use of hand and machine tools, and the characteristics of the different materials worked. Particular attention is given to the form, setting, grinding and tempering of tools and the mechanism of the different machines involving certain speeds, feeds, etc. The course is so planned that the instruction in each typical operation shall conform as nearly as possible to commercial machine-shop practice on textile machinery. The list of tools which appears under "Equipment" in this Bulletin gives an idea of the scope of the work, which includes chipping and filing, tool grinding and tempering, straight and taper turning, screw cutting, drilling and boring, planer work; milling machine work, including gear cutting. [Course VI, Options G, C, W.]

Steam Engineering—B-24. Preparation: B-12. This course consists of thirty lectures given in the first term of the second year. Its aim is to give those students who do not take the Textile Engineering Course a general knowledge of thermodynamics, the steam engine, steam turbine and gas engine and their auxiliaries, and waste heat reclamation. [Courses I, II, III.]

Applied Mechanics—B-25. Preparation: B-11, B-20. This course is divided into two parts: Graphic Statics and Strength of Materials. The first eight weeks of the semester which is devoted to Graphic Statics consists of the study of mathematical and graphical solutions for any system of forces. Centers of gravity and funicular polygons are introduced followed by roof and bridge truss problems under various conditions of dead, live, wind, and snow loading.

During the second half of the semester and during all the following semester, this course deals with Strength of Materials. So far as time permits, such topics as stress, strain, methods of testing materials, bending moments, shearing force, beam design, torsion, design of shafts, compound beams and columns, combined stresses, and like subjects, are considered.

This subject is preparatory to the work in Mill Engineering of both the third and fourth years, at which time its practical value and application are clearly demonstrated. [Course, VI, Options G, C, W.]

Advanced Textile Mechanism—B-26. Preparation: B-12, B-20, B-21. The first part of this course is a continuation of the elementary course in Mechanism (B-12); the second part takes up the study of the more complicated mechanisms used in textile machinery. Methods of mathematical and graphical analysis are applied to existing textile mechanisms, and problems of design are also included. [Course VI.]

Applied Mechanics—B-30. Preparation: B-25. This is a continuation of Applied Mechanics B-25, and is given during the first term of the third year. [Course VI, Options G, C, W.]

Electrical Engineering—B-31. Preparation: B-22. The elementary principles of electricity and magnetism are considered in the lecture course of physics. Their development and application are taken up in this course in a detailed study of the magnetic and electric circuits during the first period of the first term. The second period is devoted to a study of the principles of direct current machinery. The laboratory work consists of a study of technical electrical measurements and dynamo-electric machinery, determining for the latter their operating characteristics.

The second term is devoted entirely to a study of the principles of alternating current circuits, including vector representation, effective values, power, series and parallel circuits. The laboratory work consists of a study of technical electrical measurements, some meter calibration including that of watt-hour meters and a study of alternating current circuits using electrical measuring instruments. [Course VI, Options G, C, W.]

Electricity—B-31a. Preparation: B-22a. This is a short course given in the third year of the manufacturing courses, and consists of thirty lectures covering briefly and in a general way the theory of direct and alternating current generators and motors. [Courses I, II, III.]

Heat Engineering—B-32. Preparation: B-12, B-20. The purpose of this course is to familiarize the student with the principles of elementary thermodynamics, the properties of steam, mechanical mixtures and combustion of fuels. The course consists of thirty exercises given in the first term of the third year. The lectures and recitations are supplemented with illustrative problems assigned for home preparation.

Laboratory. The principles underlying the subjects of steamen gineering, hydraulics and thermodynamics are demonstrated in a practical manner in the work in the Engineering Laboratory, given three hours per week. Greater importance is attached to the development of initiative and responsibility in the student than the mere accomplishment of a large number of carefully planned tests. The character of this work is indicated by the following list of experiments and tests:—

Calibration of scales, tanks, gauges, inductors and counters; barrel, separating, and throttling calorimeter tests; heat exchange tests; boiler inspection and measurement; flue gas analysis; dynamometer tests; ejector and injector tests; Rankin's efficiency, actual thermal efficiency and duty tests; expansion of pipes, radiation and pipe covering tests; boiler test; trap tests, feed water heating tests; steam, triplex and centrifugal pump tests. [Course VI, Options G, C, W.]

Heat Engineering—B-33. Preparation: B-32. This course is a continuation of B-32, and consists of forty-five hours of lectures and recitations given in the second term of the third year of the Textile Engineering course. The subjects developed are the kinematics of reciprocating steam engines, steam turbines and gas engines. Special attention is given to the mechanical principles on which the

steam engine operates, with detail discussion of the valve gear and governing devices, and the various diagrams used for studying the same. Consideration is given to the underlying heat theory and to the details of construction of the various parts of the machines. During the latter part of the course the historical development, classification and types of turbines and gas engines are discussed.

Laboratory. The character of the work in the Engineering Laboratory, given three hours per week during the second half of the third year, is indicated by the following list of experiments:—

Boiler inspection and measurement; Rankin's efficiency, actual thermal efficiency and duty tests; boiler test; valve setting by measurement and by indicator; condenser test; non-condensing and condensing engine and turbine tests; heating and ventilating fan tests; lap and butt riveted joint test; nozzle test; gas engine test; flow of air and air compressor tests. [Course VI, Options G, C, W.]

Mill Engineering—B-34. Preparation: B-12, B-21, B-25. Mill Engineering, as presented in thirty lectures during the third year of the Textile Engineering course, consists of a discussion of the following topics: the selection of a site for a manufacturing plant; the investigation of the subsoils for the footing course of the foundation; wood; concrete and sheet steel piling; design of walls, beams, floors, windows, doors, stairways and roofs.

Sixty hours of drawing-room and laboratory practice are devoted to plane surveying, contour plotting, cut and fill calculations, setting of batter boards, alignments of shafting and the study from blue-prints of slow-burning construction. [Course VI, Options G, C, W.]

Mill Engineering—B-34a. Preparation: B-12, B-21. Mill Engineering, as presented in thirty lectures during the third year of the diploma courses, is largely general in its nature and includes only parts of Course B-34. [Courses I, II, III.]

Principles of Marketing—B-35. An introduction to the basic principles underlying the modern systems of distributing goods with special emphasis on the raw and finished products of the textile industry. The course will cover the history and economic importance and functions in modern distribution of the selling agent, the commission man, the broker, jobber, merchant, factor and other intermediaries as well as the channels that goods may take from the producer to the ultimate consumer. The importance and advantages of each will be studied with special emphasis on the present practice and trends in the textile industry.

Lectures and the case method of instruction will be employed. [Course VI, Sales Option.]

Marketing Methods—B-36. Preparation: B-35. A continuation of the Principles of Marketing. The course will be conducted by means of lectures and case problems and discussions. Some of the subjects studied in detail are,—the planning of marketing campaigns, the fluctuations of price and style, forecasting, the business cycle, quotas, market surveys and research, sales planning and control, industrial marketing, and consumer merchandising.

Considerable time will be devoted to the study of current literature and events in the textile field. [Course VI, Sales Option.]

Textile Physics—B-37. Preparation: B-22. The work in this subject consists of experimental determinations of the physical properties of textile fibers, yarns and fabrics. Special emphasis is placed upon the study of properties which determine the color characteristics of textile materials. [Course VI, Design and Sales Options.]

Accounting—B-40. Preparation: B-10 and E-30. The purpose of the course in accounting is to acquaint the student with modern methods of accounting for mercantile and manufacturing businesses. At the same time it gives him a much-needed knowledge of such common elementary business transactions as are involved in the use of checks, drafts, notes, vouchers, bonds and stocks.

It is not the purpose of the course to make the student a proficient bookkeeper or accountant, but the nature of the work necessitates a basic knowledge of double-entry bookkeeping and of the functions of ledger accounts. This is developed in practice in the following manner: During the summer preceding the fourth year the student is required to work up a simple bookkeeping set, thus saving valuable time during the school year and effectively preparing the ground for the instruction work.

The course includes a study of the balance sheet and profit and loss statement, and their construction in proper form. Attention is given to the principles of balance sheet valuation, and to such topics as depreciation in all its phases, sinking fund reserves, and the accounting for bond and stock issues.

One-half of the time scheduled for accounting is devoted to a study of Cost Accounting. It is designed to give the student a knowledge of the best cost methods in use at the present time, and involves a thorough discussion of methods of handling and accounting for raw materials, direct labor, and the distribution of overhead expenses. [Course VI.]

Microscopy—B-41. Preparation: B-22. This subject consists of the study of animal and vegetable fibres by means of the microscope and its accessories. It includes sectioning and mounting, measurements of diameter and twist, and the use of polarized light in the study and identification of fibers. [Course VI.]

Textile Marketing—B-42. This subject covers the problems of marketing textile products, with particular emphasis upon the ultimate consumer. The course will survey the principal marketing channels and marketing methods. Attention is directed to the possibilities of demand creation and demand control, especially through market and style research. Current changes in marketing organization of the industry will be studied and reviewed. [Courses IV and VI. Options G, C, W, D.]

Textile Testing—B-43. Preparation: B-22, F-30 or G-30, D-32. This course is planned to familiarize the student with the latest methods and devices for determining the physical properties and characteristics of textile fibers, yarns and fabrics. The scope of the work is indicated by the following topics: abrasion, absorptability, atmospheric control, bursting, crimp, heat transmission, porosity, regain, resilience, stretch, tear, tensile strength, thickness, twist, waterproofness, precision of measurements, interpretation and presentation of data. These are treated both from the standpoint of commercial testing and of textile research.

Electrical Engineering—B-44. Preparation: B-31. During the first term a detailed study of the alternator is made, with particular stress on generation of three-phase currents. Methods of predetermination of alternator regulation are taken up and at least one method compared with laboratory test. Parallel operation of alternators with acccompanying instruments and devices are studied in classroom and laboratory. The single phase, three-phase and Scott transformers are considered in turn and their various methods of connecting to line and alternators are systematically studied.

In the second term the induction motor and generator are studied with their particular adaptability to the textile industry. The principal starting devices for this motor are thoroughly taken up. The synchronous motor is studied particularly in relation to its ability to correct power factor. In all the work outlined above, the main features are illustrated profusely in classroom demonstrations and laboratory exercises. [Course VI, Options G, C, W.]

Mill Engineering—B-45. Preparation: B-11, B-12, B-21, B-23. This work, given in the fourth year of the Textile Engineering course, covers a wide range of subjects and is of the most practical character possible. All of the student's previous work in engineering and his knowledge of the textile processes are here brought together in the consideration of the larger problems of mill design, construction and organization. After a detailed study has been made of the most modern types of mill buildings, including all calculations and drawings, the student is given the problem of laying out and completely designing a textile mill so far as time permits.

The modern methods of power transmission and the proper arrangement of textile machinery are also given careful consideration. The problems are in every case taken from actual conditions in mills already built or in process of construction. The question of mill heating, ventilation, lighting, humidification and fire protection is also studied, and the time spent in the drawing room enables the student to work out nearly all of the more important problems involved in the design of an entire textile mill plant. The close relation existing between proper plant design and economical production is also considered. [Course VI, Options G, C, W.]

Business Administration—B–46. Preparation: B–10 and E–30. In recognition of the great advances which have been recently made towards better methods of management, and of the possibilities which may result from its application to the textile industry, a course in business administration has been established to enable the student to understand and apply the principles and details of modern management. The instruction in this course begins with a consideration of the factory location and design and their effect on efficiency of production, after which the proper form of organization for manufacturing establishments is discussed in detail, together with organization charts and records.

This is followed by a study of the details of the work of the various departments, such as purchasing, manufacturing, planning, etc., and includes such topics as purchasing systems, storekeeping, perpetual inventories, warehousing, scheduling, routing, tracing, timekeeping, motion studies, time studies, mnemonic symbolizing, graphical records, wage systems, etc. Consideration is also given to the important relation of psychology to efficient management. The work is further supplemented by visits to plants where methods of production and management can be observed at first hand by the students.

Business Law. Under this subject are given lectures, supplemented by the use of a suitable text, on the law governing contracts, negotiable instruments, sales, bills of lading, real estate and corporation. [Course VI.]

Mill Illumination—B–47. Preparation: B–22. Because of the demand and the necessity for proper lighting of textile mills, this course is offered three hours per week for one term. It consists of three major parts,—photometry, illumination and installation design. Costs and estimates, safety and production, are included.

The laboratory exercises include the study and applications of the photometer, Macbeth Illuminometer and foot-candle meter. The concluding work is a design of a lighting installation for a typical mill room, using the school laboratories for this purpose. [Course VI, Options G, C, W.]

Electives—B–48. Students in the fourth year of the Textile Engineering course will be permitted to elect certain textile subjects as substitutes for part of the time scheduled for engineering subjects. Thus a student is offered an opportunity for specialized study along such lines as will prove most beneficial to him at that time. The selection of elective studies is subject to the approval of the head of the Textile Engineering department and to the possibility of arranging for the same. [Course VI, Options, G, C, W.]

Principles of Selling and Advertising—B–49. A comprehensive course dealing with the fundamental principles of advertising and selling. The course will cover the psychology of selling and advertising, the legal restrictions in marketing, advertising technique, copy writing, layout, illustrations, advertising campaigns, packaging, advertising mediums, industrial and consumer advertising, creative salesmanship personality, types of customers, the selling process, super-salesmanship, etc.

Lectures and the case method of instruction will be used. [Course VI, Sales Option.]

Textile Styling and Merchandising—B–50. This course will correlate the technical knowledge of design, acquired previously, to the fluctuations of style design, the creation of fads and the forecasting and planning of styles.

The methods of merchandising textiles and the manner and form of presenting them to the ultimate consumer will be studied in detail. [Course VI, Sales Option.]

Foreign Trade and Economic Geography—B–51. The course will cover the foreign markets for finished textiles and the American raw fibres, methods of selling employed, foreign commercial law that an American exporter needs, the foreign fibers and textiles and their importance in international trade.

Special emphasis will be given upon costs of foreign marketing, tariffs, international competition, possible markets and methods of building an export business. [Course VI, Sales Option.]

Selling Policies—B–52. This course will cover the development of administrative policies and guiding principles in the marketing, pricing, styling and merchandising of textiles and textile fibers. [Course VI, Sales Option.]

CHEMISTRY AND DYEING DEPARTMENT—C

Elementary Chemistry (Inorganic and Organic Chemistry)—C-10. Preparation: Admission Requirements. Instruction in Elementary Chemistry extends through the first year, and includes lectures, recitations and a large amount of individual laboratory work on the following subjects:—

Inorganic Chemistry

NON-METALLIC ELEMENTS.—Their occurrence, properties, preparation, chemical compounds, etc.

METALLIC ELEMENTS.—Their occurrence, properties, metallurgy, chemical compounds, etc.

THEORETICAL CHEMISTRY.—Fundamental laws and the theories of chemistry including chemical action, chemical combination, combining weights, atomic weights, chemical equations, acids, bases, salts, Avogadro's law, molecular weights, formulæ, valence, periodic law, etc.

Throughout this course special attention is given to the relationship which exists between the science of chemistry and the properties of the materials used in the various industries and the chemical reactions depended upon for the maintenance of industrial processes.

The laboratory work of this course includes the experimental study of the above subjects and also a preliminary study of the qualitative detection of the more common metals and non-metals, preparatory to Course C-11.

Organic Chemistry

This course includes a general survey of the fundamental principles of Organic Chemistry, also a study of the hydrocarbons and their derivatives from the point of view of their structure, preparation and uses. This work, although elementary in character, is of sufficient breadth to prepare the student understandingly for the general lectures upon Coal Tar dyestuffs which are given in Course C-20. [All courses.]

Qualitative Analysis—C-11. Preparation: C-10, taken simultaneously. Qualitative Analysis is studied during the second term of the first year. The work consists of conferences and laboratory work. The student must become familiar with the separations and the detections of the common metals and acids by the analysis of a satisfactory number of solutions, salts, alloys and pigments. At intervals during the term short laboratory tests are given as well as the regular written examinations.

When sufficiently advanced, students take up the examination of various products with which the textile chemist must be familiar such as testing mordanted cloths, pigments and the various dyeing reagents.

During the latter part of this course a certain amount of time is devoted to the preliminary operations of quantitative analysis, such as the precipitation and washing of such substances as barium sulphate, magnesium ammonium phosphate and calcium oxalate, although no weighings or actual determinations are made.

A student's marks in this subject depend as much upon the neatness and care used in manipulation as upon the actual results obtained. [Course IV.]

Textile Chemistry and Dyeing—C-20. Preparation: C-10, B-12, B-14. The outline of the lecture course which is given during the second year is as follows:—

TECHNOLOGY OF VEGETABLE FIBERS.—Cotton, linen, jute, hemp, china grass. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

TECHNOLOGY OF ANIMAL FIBERS.—Wool, mohair, silk. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

TECHNOLOGY OF ARTIFICIAL FIBERS.—Study of the various forms of artificial silk, the process ot manufacture, their properties and action with chemicals, acids and heat.

Operations Preliminary to Dyeing.—Bleaching of cotton and linen; wool-scouring; bleaching, fulling and felting of wool; carbonizing; silk-scouring and bleaching; action of soap.

The bleaching of cotton cloth, yarn and raw stock is studied at length with detailed description of the various forms of kiers and machinery used; also the action of the chemicals used upon the material, and the various precautions that must be taken in order to insure successful work.

Under this heading is also included an exhaustive study of the reagents used in the emulsive wool-scouring process, and their action upon the fiber under various conditions; also the most successful of the solvent methods for degreasing wool.

Water and its Application in the Textile Industry.—Impurities present, methods for detection, their effect during the different operations of bleaching, scouring, dyeing and printing, and the methods used for their removal or correction.

The important subject of boiler waters is also studied under this heading, with a full discussion of the formation of boiler scale, its disastrous results, and the methods by which it may be prevented.

Mordants and Other Chemical Compounds Used in Textile Coloring and Classified as Dyestuffs.—Theory of mordants, their chemical properties and application, aluminum mordants, iron mordants, tin mordants, chromium mordants, organic mordants, tannin materials, soluble oil, fixing agents, leveling agents, assistants, and numerous other compounds, not dyestuffs, that are extensively used in the textile industry.

Under this heading are included the definitions of various terms and classes of compounds used by textile colorists, such as color lakes, pigments, fixing agents, developing agents, mordanting assistants, mordanting principles and leveling agents.

Theory of Dyeing.—A discussion of the chemical, mechanical, solution and absorption theories, and the various views that have been advanced by different investigators of the chemistry and physics of textile coloring processes.

Under this heading are discussed the general methods of classifying dyestuffs and the definitions of such terms as textile coloring, dyeing, textile printing, substantive and adjective dyestuffs, monogenetic and polygenetic dyestuffs.

Natural Organic Coloring Matters.—Properties and application of indigo, logwood, catechu or cutch, Brazil wood, cochineal, fustic, tumeric, madder, quercitron bark, Persian berries, and other natural dyestuffs that have been used within recent years by textile colorists.

Mineral Coloring Matters.—Under this heading are discussed the properties of such inorganic coloring matters and pigments as chrome yellow, orange and green, Prussian blue, manganese brown and iron buff.

Artificial Coloring Matters.—General discussion of their history, nature, source, methods of manufacture, methods of classification and their application to all fibers.

Special study of basic coloring matters, phthalic anhydride colors, including the eosins and phloxines; acid dyestuffs, Janus, direct cotton, sulphur and mordant colors, including the alizarines and other artificial coloring matter requiring metallic mordants; mordant acid and insoluble azo colors, developed on the fiber; reduction vat colors, aniline black and other artificial dyestuffs not coming under the above heads.

As each class of dyestuffs is taken up, the details of the methods of applying them upon all the different classes of fabrics and in all the different forms of dyeing machines are thoroughly discussed; also the difficulties which may arise in their application, and the methods adopted for overcoming them.

Machinery Used in Dyeing.—A certain amount of time is devoted to the description of the machinery used in various processes of textile coloring which is supplemented as far as possible by the use of charts, diagrams and lantern slides.

Most of the important types of dyeing machines are installed within the dyehouse of the school, and the students can be taken directly from the lecture room and shown the machines in actual operation. [First term, all courses.] [Second term, Course IV.]

Dyeing Laboratory—C-21. Preparation: C-20 taken simultaneously. Besides lectures and recitations upon the subject of Textile Chemistry and Dyeing, practical laboratory work is required. By the performance of careful and systematic experiments the student learns the nature of the various classes of dyestuffs and their coloring properties, their action under various circumstances, and the conditions under which they give the best results. The more representative dyestuffs of each class are applied to cotton, wool, silk and the various types of rayon, and each student is obliged to enter, in an especially arranged sample book, a specimen of each of his dye trials with full particulars as to the conditions of experiment, percentage of compounds used, time, temperature of dye bath, etc.

For convenience and economy most of the dye trials are made upon small skeins or swatches of the required materials, but from time to time students are required to dye larger quantities in the full-sized dyeing machines which are described elsewhere.

By the use of a small printing machine the principles of calico printing are illustrated, and by means of the full-sized dyeing machines and vats the practical side of the subject is studied. It is the constant endeavor of those in charge to impart information of a theoretical and scientific character that will be of value in the operation of a dyehouse. [Course IV.]

Advanced Organic Chemistry—C-22. Preparation: C-10. In this course, which consists of lectures and recitations, the principles of organic substitution and synthesis are thoroughly discussed and as many illustrations are used as time will permit, particularly such as are applied in the arts. The aliphatic series of hydrocarbons and their derivatives are studied for about twenty weeks, the remainder of the time being devoted to the benzine series. The aim of the course is to lay a broad foundation for the study of the chemistry of the artificial dyestuffs. Students are required to work out problems in the synthesis of various compounds, in order to become familiarized with equation writing. [Course IV.]

Quantitative Analysis—C-23. Preparation: C-11. The object of this course is to teach the fundamental principles of quantitative analysis, and to give the student an opportunity of acquiring skill in manipulating the special apparatus used in analytical procedure.

Typical gravimetric methods are taught the first term. The samples analyzed comprise salts, minerals and ores. Electrochemical analysis is carried out with the aid of a modern type of apparatus designed for rapid work.

The work of the second term consists of volumetric methods. A number of ores and commercial products, carefully chosen, are analyzed so as to give the student a varied experience.

The laboratory work is supplemented by lectures and recitations. Smith's "Quantitative Chemical Analysis" is used as a text. [Course IV.]

Stoichiometry—C-24. Preparation: B-10, C-10. This subject is taken one hour each week during the second year. The application of the metric system is thoroughly studied, and problems are worked involving the expansion and contraction of gases, determination of empirical formulae, combining volume of gases and chemical calculations, especially those of quantitative analysis. [Course IV.]

Quantitative Analysis—C-30. Preparation: C-23. The fundamental principles acquired in Course C-23 are applied in this course in the examination of materials used in the textile mill, the dyehouse, and the finishing plant. Among the materials analyzed are water, soaps, oils, textile fabrics, stripping agents, acids and alkalies. The latest and most practical methods are employed. Griffin's "Methods of Technical Analysis" is used as a text. [Course IV.]

Industrial Chemistry (Lecture)—C-31. Preparation: C-22. During the second term of the third year lectures and recitations are held in industrial chemistry, the course in general following Roger's "Manual of Industrial Chemistry." Particular attention is paid to those subjects which are of special interest to the textile chemist, as oils, soaps, gas and coal-tar industry, building materials, and the manufacture on a large scale of important chemical compounds, such as the common acids and alkalies, bleaching powders, various mordants, etc. The course is illustrated as far as possible with specimens diagrams and charts, and the students

are given an opportunity to visit some of the industrial establishments in the vicinity of Lowell and Boston. [Course IV.]

Advanced Textile Chemistry and Dyeing—C-32. Preparation: C-20, C-21. This is a continuation of the Textile Chemistry and Dyeing course of the second year, and includes a review of the second year's work in this subject, with the introduction of many advanced considerations, and, in addition, the following subjects:—

Classification and Construction of Artificial Dyestuffs.—A study from a more advanced standpoint of the classification and constitution of artificial dyestuffs including the various methods used in their production, also the orientation of the various groups which are characteristic of these compounds and their effect on the tinctorial power of dyestuffs.

The object of this study is to give the student a more complete knowledge of the artificial dyestuffs from the color manufacturer's point of view, which will prove of particular value to those who intend later to enter the employ of dyestuff manufacturers or dealers.

Color Matching and Color Combining.—A study of that portion of physics which deals with color and the many color phenomena of interest to the textile colorist. The lecture work is supplemented with the practical application of the spectroscope and tintometer, and much practice in the matching of dyed samples of textile material.

The primary colors both of the scientist and textile colorist, the results of combining coloring lights and pigments, and such subjects as color perception, color contrast, purity of color, luminosity, hue, color blindness, dichroism, fluorescence and the effect of different kinds upon dyed fabrics, are discussed under this heading.

Each student's eyes are tested for color blindness early in the course, in order that he may be given an opportunity to change his course if his eyes should prove defective enough to interfere with his work as a textile colorist.

A dark room has been provided where various experiments in color work and color matching may be performed.

Dye Testing.—This subject includes the testing of several dyestuffs of each class, subjecting them to the common, color-destroying agencies; the determining of their characteristic properties, and their action towards the different fibers; also the determining of the actual money value and coloring power of dyestuffs in terms of a known standard.

Each student is required to make a record of each color tested upon an especially prepared card, which furnishes a permanent record of all dyestuffs, their dyeing properties, fastness to light and weather, washing, soaping, fulling, perspiration, bleaching, steaming, ironing, rubbing, acids and alkalies.

Union Dyeing.—A study of the principles involved in the dyeing of cotton and wool, cotton and silk, and silk and wool union materials in the production of solid and two-color effects.

Textile Printing.—A thorough study of the whole subject of textile printing, each student being required to produce individually no less than twenty different prints, including the following styles; pigment style, direct printing style, steam style with tannin mordant, steam style with metallic mordant, madder or dyed style, the ingrain or developed azo style, discharge dye style, discharge mordanted style, resist style, indigo printing, aniline black printing.

The different parts of the calico printing machine are thoroughly studied; also the precautions which must be considered in its use, and the arrangement of the dyeing apparatus which must accompany such a machine.

Special attention is paid to the methods of mixing and preparing the various color printing pastes that are used in the above work upon a manufacturing scale as well as experimentally in the laboratory.

Cotton Finishing.—A study of the various processes of finishing cotton cloth and the different materials used therein. The work involves the discussion of the various objects of cotton finishing and such operations as pasting, damping, calendering, stretching, stiffening, mercerizing, beetling and filling, and the various machines used for carrying out these processes.

Mill Visits.—During the third and fourth years visits are made to some of the large dyehouses, bleacheries and print works in the vicinity. [Course IV.]

Physical Chemistry—C-33. Preparation: B-20a, B-22, C-22. This subject is given during the third and fourth years, and includes a study of the fundamental laws and theories of chemistry, and the application of physical measurements to chemistry with illustrative problems. Special attention is given to textile applications. [Course IV.]

Advanced Organic Chemistry—C-34. Preparation: C-22. This is a continuation of Advanced Organic Chemistry C-22. [Course IV.]

Technical German—C-35. Preparation: E-21, C-20, C-22. This course consists of the reading of German technical literature, with the object of familiarizing the student with the current German publications in textile chemistry and coloring. [Course IV.]

Organic Chemistry Laboratory—C-36. Preparation: C-20, C-22, C-23. This course, while including practice in the usual methods of organic analysis, and giving excellent training in the principles and manipulations of general organic synthesis, is especially devoted to the synthetic dyestuffs. The student not only prepares many of the representative dyestuffs, but, what is far more important, he carries out all the operations, beginning with coal tar itself. Thus, instead of merely coupling two or more of the foreign imported intermediate products to make a dyestuff, he starts with the basic substances obtained from the coal tar and makes his own intermediate products. As far as is possible the student will be made acquainted with the problems which might arise in a dyestuff factory, and an excellent opportunity is presented for original work. [Course IV.]

Photography—C-37. Preparation: B-22, C-20, C-22, C-23. Photography is today indispensable to the scientist and textile chemist. Without the aid of photography he cannot preserve and keep an absolute and accurate record of his investigations and research problems.

The Institute therefore offers to the Senior Chemists an eight-weeks course in the elements of Photography. One object of this course is to provide the student with the preliminary knowledge and training necessary for the course in Microscopy and Photomicrography which follows.

The course includes a study of the different types of cameras and lenses, the making of contact prints from classified negatives using various grades of papers, reduction and intensification of negatives, enlarging, copying, negative making and lantern slide preparation.

The theory and chemistry of the above subjects are not only covered in the classroom but in addition all of this work is actually carried on by each individual student in the Photographic Laboratory and Dark Room. [Course IV.]

Technical German—C-40. Preparation: C-35. This is a continuation of Technical German C-35. [Course IV.]

Organic Chemistry Laboratory—C-41. Preparation: C-34. This is a continuation of Organic Chemistry Laboratory C-34. [Course IV.]

Physical Chemistry—C-42. Preparation: C-33. This is a continuation of Physical Chemistry C-33. [Course IV.]

Chemical Textile Testing—C-43. Preparation: C-21, C-32. A series of lecture and laboratory periods covering the theory and use of the instruments and apparatus used in testing and evaluating textile materials. Emphasis is given to those tests which may be used to give a chemist valuable information as to the source and quality of textiles. The last part of the work consists of chemical and optical tests which may be necessary to a textile chemist in either routine or research work. [Course IV.]

Advanced Textile Chemistry and Dyeing—C-44. Preparation: C-32. This is a continuation of the third-year work in Advanced Textile Chemistry and Dyeing, and includes the following subjects:—

Advanced Organic Chemistry (Dyestuffs). Advanced study of the coal-tar coloring matters, their chemistry, relations of their compositions to their coloring power, and the chemistry of their preparation.

Economics of the Dyeing, Bleaching and Finishing Industries.—A study of the factors to be considered in the establishment of a dyeing, bleaching

and finishing plant together with the most essential considerations of its management.

Advanced Dyeing Conference.—During the latter part of his course each student will be required to write, for presentation before the other members of his class, a paper upon some assigned subject of general interest. After presentation the subject will be open to discussion and question.

The object of this conference is twofold. First, to give the student experience and practice in systematically looking up an assigned subject and presenting it before others; and secondly, to bring before the class a greater variety of subjects with more detail than could be covered by the general lectures of the course. [Course IV.]

Microscopy and Photomicroscopy—C-45. Preparation: B-22, C-20, C-22, C-37. The value of the microscope in the identification of textile materials and the examination of textile yarns and fabrics cannot be overestimated. In conjunction with photomicroscopy a permanent record which may be filed for future reference and which is understandable by non-technical men is obtained.

In this course the students are given instruction in the use and construction of various types of microscopes and accessories; the preparation and mounting of samples; the identification of starches and fibers; microchemical reactions; and examination of fabrics for faults. Actual unknown fibers, starches and fabrics are examined and reported upon.

Following microscopy, the student takes up photomicroscopy, for which he has been prepared by a thorough course in the common processes of photography. The types and constructions of photomicrographic apparatus, adjustments, and exposures are taught by actual work in the photomicrographic laboratory. The student studies the use of such auxiliaries as color filters, polarized light, dark-ground illumination, color photography, and works at both high and low magnifications. At the end of the course the student is given a typical industrial or research problem on which he works independently and upon which he must prepare a complete report, illustrated by appropriate photomicrographs. [Course IV.]

Quantitative Analysis—C-46. Preparation: C-30. This course consists of lectures, recitations and quizzes on the fundamental principles of analytical chemistry. [Course IV.]

Report Writing—C-47. Preparation: B-20a, E-20. The purpose of this course is to enable the student to write a technical report clearly. An analysis of a complete research is first made. This is followed by a bibliography and instructions in the use of reference books and technical journals. Methods of obtaining and interpreting laboratory data are given and the elements of statistical analysis demonstrated and used. Instruction and illustrations of various technical and non-technical, formal and informal, laboratory and plant reports are given. [Course IV.]

Textile Literature—C-48. Preparation: C-47. The object of this course is to introduce the student to the current sources of information on textile chemical subjects. Each student is assigned a subject and is required to keep informed on that subject by first a survey of the literature and then the reading of current technical journals. Reports are tendered informally and orally. [Course IV.]

Advanced General Chemistry—C-49. Preparation: C-10, C-11, C-24, C-34, C-42, C-46. The object of this course is more to correlate the various branches of chemistry studied in the previous three and one-half years than to introduce new material. An attempt is made to show the essential oneness of all chemical knowledge. Recent theories are discussed briefly. [Course IV.]

Engineering Chemistry—C-50. Preparation: C-22, C-23. This course consists of a series of lectures covering the derivation, sampling, analysis, and specification of coals, gasolines, kerosenes, fuel gases, flue gases, oils, greases, and boiler waters. This is followed by a study of combustion and the underlying principles of lubrication. The lectures are supplemented by laboratory work consisting of complete analyses of coal, gasoline, oil, grease, flue gas, and illuminating gas. [Course IV.]

The Chemistry of Rayon, Its Manufacture, Bleaching, Dyeing and Finishing—C-51. Preparation: C-32. During the past five years the develop-

ments of the bleaching, dyeing and finishing of rayon have been systematically studied and the curriculum of the Chemistry and Textile Coloring course has been revised from time to time to cover the latest developments in regard to these fibers. There is being installed at the present time a complete unit for the actual manufacture of rayon, and with this available for experimental and demonstration purposes, it is anticipated that during the coming year instruction upon the production and subsequent treatment of rayon will be greatly amplified.

Many of the difficulties which arose during the early days of the artificial silk industry were due to lack of knowledge of its properties and more or less persistent attempts to handle it in just the same manner as real silk. As soon as the textile manufacturer began to fully appreciate the fact that the various rayons were entirely different fibers from true silk and consequently must be handled by different methods, then many extensive improvements were made in the processes of manufacturing textiles containing these fibers. In order to satisfactorily handle the different rayons they must receive a preliminary treatment with various oils and softeners, and as a result the problem of establishing the specifications for the best type of oil to use for this purpose and also the best methods of removing it from the material during the finishing process have been important problems in the development of the industry, and these among others are being studied in the Lowell Textile Institute at the present time. [Course IV.]

Optional Subjects or Thesis during fourth year—C–52. Preparation: Satisfactory completion of all first and second year subjects in Course IV. The value of undergraduate thesis work for all students has frequently been questioned. There is no doubt that many senior students might take optional work of an advanced nature to greater advantage than devoting the same amount of time to specific thesis work. With this in mind beginning 1931–32 several options were introduced, each optional period being 45 hours per term and four of these being required during the year.

If a student has indicated through the first three years of his work that he is capable of handling an original investigation, a definite thesis subject may be assigned to him which will require the entire 180 hours. At the discretion of the Head of the Department, thesis subjects involving one or more option periods may also be assigned.

In all cases, however, 180 hours' work of an advanced nature, either of thesis work or optional subjects, will be required for graduation.

Options: Textile Chemistry Laboratory. A laboratory course on some branch of textile chemistry varying from year to year.

Photomicroscopy. A series of laboratory experiments followed by a research problem in photomicroscopy. Effects of the optical system, exposure, polarized light and dark ground illumination are studied and color photomicroscopy is included as far as time permits.

Colloid Chemistry. A seminar course on general colloid chemistry with special applications to textiles. The colloid chemistry of dyeing, the action of detergents, and the swelling effects of various materials on the fibers are especially emphasized.

Microbiology I. This course gives a general survey of the effect of the various micro-organisms on textile materials. Consideration is given to the methods of studying molds and bacteria and the methods of preventing their growth on textiles. In the laboratory the solution, identification and properties of the organisms are studied. The detection of micro-organisms on fibers and damage to fibers caused by their growth is studied in detail. Methods of testing antiseptics to be used on textiles are also studied.

Microbiology II. A continuation of Microbiology I, laying special emphasis on the branch of microbiology in which the student is most interested. No lectures are given but each student is required to do certain reading and frequent conferences are held with the instructor. In the laboratory each student selects some problem and works it out as thoroughly as time permits.

Rayon. Laboratory practice in manufacture of viscose rayon.

Physical Chemistry. Measurement of molecular weights, heats of reaction, vapor pressure, surface tension, hydrogen ion concentration, electrical conductivity, etc.

TEXTILE DESIGN AND WEAVING DEPARTMENT—D

Textile Design and Cloth Analysis—D-10. During the first year instruction is given in the subject of classification of fabrics, use of point or design paper, plain fabrics, intersection, twills and their derivation, sateen, basket and rib weaves, checks and stripes, fancy weaves, including figured and colored effects; producing chain and draw from design, and *vice versa;* extending and extracting weaves.

This subject takes up in a systematic manner the analysis of samples illustrating the various cloth constructions for the purpose of determining the design of the weave and the amount and kind of yarns used, and forms the basis of calculation in the cost of reproducing any style of goods. The various topics discussed are reeds and setts; relation and determination of counts of cotton, woolen, worsted, silk and yarns made from the great variety of vegetable fibers; grading of yarns, folded, ply, novelty and fancy yarns; application of the metric system to yarn calculation; problems involving take-up, average counts, determination of counts of yarn, and weight of yarn required to produce a given fabric. [First term, all courses.] [Second term, Courses I, II, III, VI.]

Textile Design and Cloth Construction—D-20. For Cotton Goods—Preparation: D-10. During the second year consideration is given to fancy and reverse twills, diaper work, damasks, skip weaves, sateen fabrics with plain ground, backed fabrics, and multiple ply fabrics. Students are required to make original designs and put the same into the loom. Special attention is given to the consideration of color effect.

During the first term free-hand drawing is taught by means of plates, and practice in coloring is given in conjunction with this work.

Practice in lettering, spacing and general arrangement of designs and sketches is given. The engineering alphabet is used in all work.

During the second term instruction is given in drawing, sketching, coloring and designing, with reference to their application in textiles. Good examples of applied design in textiles, as well as in other branches, are used as a basis for modified designs selected and composed by the student. This stimulates originality as well as teaches the student to appreciate good designs and color.

The analysis of these fabrics forms a part of the course in design. This also includes the necessary calculations required to reproduce the fabric or to construct fabrics of similar character. [Courses I, III, VI.]

Textile Design and Cloth Construction—D-21. For Woolen and Worsted Goods—Preparation: D-10. During the second year the instruction given includes warp and filling backed cloth, figured effects produced by extra warp and filling, double cloths, multiple ply fabrics, cotton warps, blankets, bathrobes, crepes, filling reversible, Bedford cords, imitation furs, crepons, matelasse and imitations, double plain, ingrains, velvets, corduroys, overcoatings, trouserings.

The analysis of these fabrics, together with the consideration of the shrinkages and dead loss in all fabrics, theory of diameter of yarns, and costs of blends and mixes is a part of this course. [Courses II, III, VI.]

Jacquard Design—D-22. This course is given during the second term of the second and third years. It covers detail instruction of the Jacquard machine and the various tie-ups in common use, the layout for different kinds of fabrics, and the cutting of cards in accordance with prepared designs. The adaptation of various designs to woven fabrics through the aid of cross section paper and its correlation with the different types of looms and Jacquard machines are thoroughly covered. The student is encouraged in original designs and such of these as meet approval are carried out in woven goods.

Textile Design and Cloth Construction—D-30. Preparation: D-20 or D-21. The advanced work takes up the more complicated weaves adapted to harness work, and leads into leno and Jacquard designs. The following is a brief list of the subject heads, which will give some idea of the course: double plain cloths, ingrains, tricots, chinchilla, tapestry, blankets, upholsteries, spot weaves, pile or plush, crepon, matelasse and its imitations, pique, Marseilles, quilting, and miscellaneous designs for Jacquard, leno, fustian, tissue fabrics and lappets.

Original designs and sketches for particular grades of goods and the study of color effects form an important part of the third-year course. It should be understood that work in decorative art is carried on in conjunction with textile construction and weaving, particularly on the Jacquard loom. Designs of merit are carefully developed in detail and woven into cloth.

The work in cloth construction includes the application of the different weaves and their combinations in the productions of fancy designs, both modified and original; the calculation involved in the reproduction of standard fabrics changed to meet varying conditions of weight, stock, counts of yarn and value; and the discussion of the breaking strength of fabrics and relationship of the construction of the fabric to breaking strength.

Instruction in this subject, which is given by classroom work, is intended to bring together the principles considered under the subject of design, cloth construction, weaving and yarn making of previous years, and to show the bearing each has in the successful construction of a fabric. [Courses III, VI.]

Decorative Art for Special Students. This course is planned to give a student a working knowledge and appreciation of design. The first and second years are devoted to a general study of design, color, perspective, lettering and rendering. Drawings are made in the historic styles for all materials,—wood, gold, silver, copper, brass, leather, fabrics, wall papers and glass.

In the third year students should specialize and devote their attention to the material in which they expect to work.

Jacquard Design—D–31. This is a continuation of Jacquard Design D–22.

Power Weaving—D–23. Preparation: D–10. In connection with the work in Textile Design and Cloth Analysis practical work is carried on upon the power looms. This includes the preparation of warps, beaming, dressing, sizing, drawing-in and making of chains, the cutting and lacing of cards, spooling and quilling and the machinery for the same. A study is made of warpers and sizing machines, both for cotton and woolen. Lectures are given to correspond with the progress of the student in the Power Weaving Laboratory covering the following subjects: loom adjustments, chain building, shuttle changing looms, dobby looms, single and double acting dobbies, handkerchief motions, leno weaving, center selvedge motion, filling changing looms, oscillating reeds, lappet motions, various shaker motions, towel and other pile cloth weaving, Jacquard looms, single and double lift leno Jacquards, Jacquards of special design, tying up Jacquard harness. [Courses I, II, III, VI.]

Power Weaving—D–32. Preparation: D–20, D–21, or D–22. Instruction is given in weaving on fancy woolen and worsted looms, single and double acting dobbies, leno weaving, various shaker motions, lappet loom weaving, double and single lift Jacquard looms, tying up Jacquard harness, leno Jacquard, harness and box chain building; warp preparation for woolen and worsted and cotton; formulas for making up different kinds of sizing. Lectures are given to correspond with the same. [Courses I, II, III, VI.]

LANGUAGE AND HISTORY DEPARTMENT—E

English—E–10. Preparation: Admission Requirements. A technically trained man should be able to express himself clearly, forcibly and fluently, as inability to do so will be a serious handicap to him in after life. The object of the English course is to develop the student's power of expression by a thorough study of the principles of advanced rhetoric and composition, and by constant writing of themes illustrative of the four forms of discourse, viz., description, narration, exposition and argumentation. In addition to the study of rhetoric and composition and the writing of themes, several classics such as are not read in the preparatory schools are studied and discussed. [All courses.]

Elementary German—E–11. Preparation: Admission Requirements. This course is intended for first-year students who do not offer German as an entrance requirement and who desire to take the course in Chemistry and Textile Coloring. It may be selected by students taking the Textile Engineering course who have not fully met the entrance requirements in language. The work is ele-

mentary in character, and much time is devoted to the study of the rudiments of German grammar with practice in composition. During the latter part of the year considerable attention is given to the reading of ordinary German prose, which serves as an additional preparation to the student for the later reading of works along scientific and industrial lines. [Course IV.]

English—E–20. Preparation: E–10. The curriculum of this course is based upon the sound belief that the young man about to enter business can profit much by the study of the principles and the rules of standard English as applied to business writing. The student is given a comprehensive remedial review of the fundamentals of grammar in their relation to practical expression in writing letters and reports. Class discussions of actual quoted letters, collateral readings, and home preparation of written assignments afford the student abundant opportunity to enlarge his vocabulary and to improve his style. During the second semester, modern essays and other works of fiction are read and discussed. The course meets twice each week. [Course IV.]

Advanced German—E–21. Preparation: E–11. For students taking the course in Chemistry and Textile Coloring the elementary course of the first year is continued throughout the second year. The work consists of the study of some of the more advanced principles of grammar, and especially of the reading of scientific German, dealing with a variety of subjects, and the translation of commercial German. [Course IV.]

Economics—E–30. Preparation: E–10. This course, meeting three times a week, is conducted by means of lectures, discussions, and recitations, supplemented by textbook reading and study of charts analyzing various phases of industrial problems. The character of the course is descriptive and practical rather than theoretical, and the aim is to acquaint the student with the accepted principles of economics and some of their applications to industrial conditions.

The course will also deal briefly with economic history, showing how the present economic system has evolved from past systems and pointing out how the experience of the past can aid in the solution of present problems.

Besides the historical material, other topics discussed are the nature and scope of economics; the evolution of economic society; the three factors of production, land, labor and capital; the four elements in distribution, rent, wages, interest and profits; business organization; value and price; monopoly; money, credit and banking; international trade; protection and free trade; transportation; insurance; economic activities of municipalities; and public finance. In short, it is an outline course dealing with the fundamental principles that underlie a wide range of activities. [Courses IV, VI.]

COTTON DEPARTMENT — F

Cotton Carding—F–20. Preparation: B–10, B–12, B–14. This course extends throughout the second year and includes instruction starting with the growth, classes and characteristics of cotton and continues on through all the mill operations preparatory to spinning.

Cotton Production.—A study of the areas of the world producing cottons and the characteristics of the world's commercial cottons forms the major portion of this division of the work. Particular emphasis is given to the various American cottons. The different methods of ginning and the by-products from the cotton seed are studied here.

Cotton Marketing.—The customary methods of concentrating and distributing raw cotton come under this heading, which includes a study of the handling of cotton for spot sales and through the exchanges. It includes also a study of the classing of cottons, which involves instruction regarding the Federal Standards for classing and the terms commonly used by mills in handling purchases of cotton.

Opening.—The various machines used in opening raw cotton are studied in considerable detail, following which, typical layouts of the various machines in series, as used by different mills, are taken as illustrations of how these machines can be arranged for various conditions.

Picking—Particular emphasis is used in instructing the student in the new arrangements being developed for the picker room. Such standard subjects as eveners, lap measuring motions, grids and beaters are followed with illustrations of their application to the single process pickers. The effect of varying humidities on proper lap weights and future results in the card room are clearly pointed out under this heading. Draft, production and waste calculations complete the instruction on pickers.

Carding.—The process of carding is considered one of the most important, and proper time is devoted to the construction and operation of cards, that the student may be familiar with the various parts of the card and the function and design of each. The construction and application of card clothing, as well as the methods of grinding, form a part of the work. The proper procedure for operating cards to get the proper size and production and to keep them in proper mechanical condition to produce good work occupy considerable of the time given to carding. The calculations for draft, production and percent of waste completely cover these subjects as connected with carding.

Drawing.—Under this head is taken up the theory of doublings and their effect upon the quality of roving and yarn. Like previous and subsequent processes the machine construction forms an important part of the work. Proper stress is paid to such subjects as stop motions, drawing rolls and their covering, cleaners and evener motions. The calculations cover draft, production, roll crimp and improvement in uniformity.

Combing.—This process is explained by lecture work and by operation and assembling of the various types of combs in service in the laboratory. The object of combing is fully considered, and the different means employed on the many types of combers on the market is studied. This includes such types as the Heilman, New Whitin and Nasmith combers. Considerable time is spent in studying the many comb adjustments, their purpose and how they should be used to produce the desired quality of work. The proper care of the comb is explained. The subject includes the necessary calculations for draft, noilage and production.

Roving.—Under this heading the frames called the slubber, intermediate, fine and jack are studied. The numerous changes and adjustments necessary to produce good work are stressed, with special emphasis on the less obvious subjects of lay and tension. Both English and American types of frames are used. The cotton system for sizing rovings and yarns is studied here, following which, such calculations as draft, twist, lay, tension and production complete the work of the roving operations.

Laboratory.—An extensive series of laboratory projects are carried out simultaneously with the lecture instruction. These laboratory classes illustrate the principles developed in the class room and extend the class room work to practical application and operation. After work in classing raw cottons, cotton is processed using different adjustments, thus showing the results of the changes. Sufficient quantities of stock are processed so that the roving made is later spun into yarns and manufactured into cloth by the student. [Course I.]

Cotton Carding—F–20a. Preparation: B–10, B–12, B–14. This course is similar to Course F–20, except that there is much less time devoted to lecture and laboratory work. [Courses III, VI.]

Cotton Spinning—F–30. Preparation: F–20. This course extends throughout the third year and includes instruction on spinning, spooling, winding, twisting, reeling and baling.

Ring Spinning and Twisting.—This part of the course covers all kinds of ring spinning and twisting frames, their construction, principles of their actions and calculations. Particular emphasis is given to the production of yarns for different uses, in order that the desirable characteristics may be obtained. As the twister so closely resembles the spinning frame in many ways, the two operations are studied in succession to avoid duplication. The defects commonly found in yarns and methods of eliminating them require considerable attention. The methods of sizing yarns and the calculations for determining draft, twist and production are important factors in this work.

Mule Spinning.—Although less common than formerly in American mills, the mule is still of sufficient importance to warrant a study of its major motions. The advantages of mule yarns are clearly shown and the more common calculations for draft, twist and production are given.

Spooling and Winding.—These methods of preparing yarns for twisting and warping are fully explained. The machines are studied for the mechanical construction and adjustment. The calculations are largely in connection with production.

Reeling and Baling.—This work covers the winding of yarns into skeins on various types of reels, the calculations for producing skeins of a desired size and the adjustment of stop motions for measuring the desired yardage. The packing of skeins into bales follows the reeling.

Laboratory.—The laboratory work for this course consists of a series of projects particularly intended to illustrate the important features of the various machines and their products. In addition, considerable time is spent in producing yarns in sufficient quantities to give the student some practical experience in operating the machine and handling the rovings and yarns required. [Course I.]

Cotton Spinning—F–30a. Preparation: F–20a. This course is similar to Course F–30 except that there is much less time devoted to laboratory work. [Course VI.]

Knitting—F–31. Preparation: B–12, D–10. This course, commencing with a study of hosiery yarns and their preparation for knitting, includes a study of the various stitches and their application in commercial fabrics; a study of the different knitting machines, including circular and flat, spring and latch needle machines, used in the manufacture of stockings, sweaters and underwear; and a study of looping and sewing machines. Part of the work consists of the assembling and adjusting of different types of knitting machines.

In addition, considerable time is spent in the analysis of knitted fabrics. [Courses I, II.]

Knitting—F–31a. Preparation: B–12, D–10. This course embraces the same lectures as Course F–31 but does not include any laboratory work. [Course VI.]

Cotton Organization—F–32. Preparation: F–20 or F–20a. This course correlates all the work in the Department of Cotton Yarns. The student is instructed how cotton yarn mill organizations are made, by the study of actual mill organizations, showing the drafts, doublings and sizes in use. This is followed by the calculation of machinery necessary to equip a given plant and the arrangement of this machinery in the mill building. Some time is given to the study of special equipment not specifically covered in other classes. [Courses I, VI, Options G, C.]

Thesis—F–34. Each student is required to present a thesis which is a report of some original work. This is sometimes the construction of some yarn or fabric to meet certain requirements. At other times the work is a study of some technical problem regarding the effect of certain changes in manufacturing conditions. [Course I.]

WOOL DEPARTMENT—G

Fibre Preparation—G–20. Preparation: B–10, B–12, B–13. Raw Materials.—A study of raw materials which enter into the manufacture of woolen or worsted yarns, or are made into yarns by processes similar to those employed in the manufacture of woolen and worsted yarns, would include silk, mohair, alpaca, vicuna, cashmere, camel's hair, cotton, flax, hemp, jute and ramie.

Wool Sorting.—Familiarity with the various grades and kinds of wool is obtained by lecture and by actual sorting of fleece wool under the direction of an experienced wool sorter. The various characteristics and properties are explained, as are also trade names, such as picklock, XXX, XX, ½-blood, ⅜-blood, ¼-blood, delaine, braid, etc. Some skill is acquired in the estimation of shrinkage and in judging the spinning qualities.

Wool Scouring.—The object of scouring and the methods employed are explained, and this involves the consideration of the soaps and chemicals used in washing; also the waste products and their utilization. Actual work is done in

scouring a commercial quantity of wool by machines that are made similar in operation to regular commercial machines. A study is made of the effect of the hardness of water upon soap; also tests are made to show this effect. At the same time the use of dryers, their operation and regulation, is taken up.

Top Making and Combing.—This branch takes up in all detail the carding of wool on a worsted card, the preparing processes, back-washing and Vigoureaux printing, also gilling of the stock before and after combing. The construction of the gill boxes and combs is studied by lectures and by dismantling and assembling these machines in the laboratories. Later, quantities of stock are made into top and then into yarn.

The Noble comb is studied, and the various calculations to determine draft, noiling, tear, productions, etc., are made. [Courses II, III, VI.]

Woolen Yarn and Shoddy Manufacture—G–21. Preparation: B–10, B–12, B–13. Reworked Fiber or Shoddy.—Rags of all kinds are studied, sorted, and all processes necessary to convert them into fiber are covered in detail.

Wool Blending, Oiling and Picking.— Mixing and shading of colors and qualities of wool are studied and practiced. The details of Burr Pickers and mixing pickers including the Fearnaught are studied in full. The importance of oils and emulsions is stressed in lecture and laboratory.

Woolen Carding.—The system of carding wool for woolen yarn is fully explained, as is also the construction, setting and operation of the cards. A part of the work is the reclothing and grinding of the cylinders, strippers, workers, etc. The carding of suitable and commercial quantities of wool, and the further manufacture of it into yarn, serves to fix the principles of carding in the mind of the student, as well as to give him some skill in handling machinery.

Woolen Spinning—The computations necessary in converting roping into yarn are fully explained. The details of construction and operation of the spring and cam type mule are well covered in lectures and practice. The theory and practice of continuous or ring spinning for woolen is also taken up. The conditioning of yarn after spinning by steaming is explained.

Costs and details of a yarn mill are mentioned in brief as well as some causes of poor yarn and its effect on mill production. [Courses II, III, VI.]

Worsted Yarn Manufacture—G–30. Preparation: G–20. Intersecting Gill Boxes and French Comb.—The equipment of the laboratory offers opportunity for the production of dry-combed top and its comparison with oil-combed top produced on the Noble comb. The structures and uses of intersecting gill boxes and the study of combing and drawing blends is taken up at this point.

Drawing and Spinning.—The laboratory equipment consisting of the Bradford (English) system of drawing, of both open and cone types, as well as the various processes of French drawing, followed by both worsted mule and ring spinning frame, make possible a thorough study of the manufacture of worsted yarn by all of the existing methods.

The same method of study of mechanisms, calculations, and operations of the various machines is followed as in the case of previous methods of instruction. The student by pursuing this course can compare the different methods of yarn manufacture and note the results of each.

Organization.—At the end of the course the layout of a properly balanced yarn mill is studied, and at the same time the cost of machinery, depreciation, labor costs and machinery arrangements.

Thesis.—Before graduation the student must present visible evidence of his knowledge of woolen and worsted manufacture by the production of twenty yards of fabric from his own design (or reproduction or modification of some existing fabric) beginning with the raw material.

A formal typewritten description, including all calculations and observations, together with samples from each machine, must be presented to the head of the department before the final examination. [Courses II, III, VI.]

Textile Testing—G–31. Preparation: B–22, F–30 or G–30, D–23. The object of this course is to familiarize the student with present-day methods of determining the physical properties of textile fibers, yarns and fabrics. The ap-

plication of physical laws and methods of measurements, as studied in the course of Physics, is used in the study of physical characteristics of textile material. The work is given to students in advanced courses, and consists of lecture and laboratory work. Reports are prepared from each experiment, giving the object of the experiment, method of procedure, observation and conclusions, in order that the student may acquire practice and understand the interpretation of data. A special testing laboratory is provided, and a considerable number of the best standard fiber, yarn and fabric testing instruments of foreign and American make have been installed and are used for instruction in the testing of textile materials. The laboratory is equipped with means for making and keeping the humidity constant, so that tests can be made under uniform or standard conditions of humidity and temperature. [Courses I, II, III.]

FINISHING DEPARTMENT—H

Woolen and Worsted Finishing—H-30. Preparation: B-12, C-10, D-10, D-23. The outline of this course, which is given by means of lecture and laboratory work, is as follows:—

Burling and Mending.—Under this head is taken up for consideration the examination of flannel as it comes from the loom; the construction, use and location of the perch; the methods used in marking defects, measuring, weighing and numbering of cloths; also the methods of inspection for fancies, single cloths and double cloths. The object of burling, mending and the types of tables employed, the method of removing knots, runners, etc., the object of back shearing and the use of burling irons, the replacing of missing threads and the importance of sewing as a part of the finishing process, are all considered in detail. The removal of oil and tar spots as well as stains of various kinds is studied.

Fulling.—This branch covers a study of the conditions of the flannel as it comes from the loom, and the influence of oil, etc., upon the procedure. Considerable time is devoted to the various methods of producing a felt, the early types of stocks, hammer falling and crank stocks, and their modifications and development into the present type of rotary fulling mills of both the single and double variety. The details of construction in all machines are carefully taken up and include the design and composition of the main rolls, methods of covering, regulation and means of adjusting the pressure of traps and rolls, consideration of the shoes, the use and regulation of the various types of stop motion, the different types of stretchers, guide rolls and throat plates.

The theory of felt is taken up and the influence of pressure, moisture, heat, alkali and acid is considered, as well as the hydroscopic and felting properties of different wool fibers. The preparation of the flannel for the mill and the usual methods of determining shrinkages, as well as the various methods of soaping, are given careful attention. The preparation of various fulling soaps and the value of each for the production of various degrees of felt as well as the determination of the proper amount of alkali for various goods, are carefully studied and demonstrated. The manipulation of the various kinds of goods in the mill, viz., all wool, shoddies and mixed goods, is studied in classroom and by operation in the mill.

The change in weight and strength for each operation is carefully considered, as is also the value of the flocks made in each. A study of the various methods of flocking, such as dry and wet, is considered in both class and machine rooms. In each operation the defects likely to materialize are studied, as well as the cause thereof, and various methods of modifying or lessening them.

Washing and Speck Dyeing.—This branch considers the scouring, rinsing and washing of goods both before and after the fulling process; the various types of washers; and the details of construction, such as suds box, rolls, etc. The theory of scouring, uses of Fuller's earth, salt solutions and scours on the different kinds of goods are made clear by practical work in the machine room, where the effects due to improper scouring, such as stains, cloudy effects, wrinkles and unclean goods, are demonstrated. The discussion of the necessity of speck dyeing follows naturally from the study of these matters, and includes methods of preparation, materials used, application and tests required.

Carbonizing.—This is an important branch of finishing, and includes a study of the various carbonizing agents, methods of application, strength of solutions, and neutralizing, as well as the machines used. Stains and imperfections resulting from carbonizing are also considered. The drying and tentering machines and extractors employed are taken up at this point.

Gigging, Napping, Steaming, Singeing and Crabbing.—The construction in detail of the various types of gigs, nappers, steamers, wet gigs, rolling, stretching, crabbing, and singeing machines is discussed, and their actions upon the cloth and the results obtained are explained.

Various methods of obtaining luster and the production of permanent finish are considered in connection with steaming and sponging.

Brushing, Shearing and Pressing.—This includes, as do the other branches, a careful treatment of the machine employed, the preparation of the cloth for each process, the action of each machine in producing its part of the resultant effect. In manipulation of the shear consideration is given to its setting, grinding and adjustment. With the brushing machine the effect of steaming and moisture upon the luster and feel of the goods is shown. A study of the action of the presses, both plate and rotary, involves consideration of pressure, steaming, etc. Special processes to obtain particular effects are taken up, and the part played by each machine is explained. The details involved in handling cloth on a commercial scale, as, for example, measuring, weighing, ticketing, numbering and rolling, are also explained. The necessary calculation and the methods of finishing all grades of goods are considered from time to time during the year. [Courses II, III, IV, VI.]

Cotton Finishing—H-31. Preparation: B-12, C-10, D-10, D-23. The outline of the course in the finishing of cotton fabrics is as follows:—

Cloth Room.—Instruction of the various goods and the object thereof; construction of the various types of inspecting and trimming machines.

Shearing.—The object. A consideration of the various types of shears for treating one or both sides at the same time; also the use of the usual cleaning devices, such as emery, sand and card rolls, beaters and brushes; grinding and the adjustment of the various parts.

The use of brushing and cleaning machines, rolling devices and calender attachments for gray goods.

Singeing.—Developing and object of singeing; the construction of singers of all types and for various purposes; the use of cooling tanks, steaming devices, rolling and brushing attachments.

Regulation of the flame for various goods, and adjustment of the parts; gas and air pressure, water-cooled rolls; the effect of moisture on the cost of singeing and use of dry cans in connection with singeing; electric singeing.

Washing.—Open width and string washers, their construction and operation: soaps, temperature, squeeze rolls; washing of various goods and the object thereof; stains.

Napping.—The object of napping and the usual method of treating goods; various types of nappers, single and double acting; felting nappers; construction, grinding and adjustments of various types.

Water Mangles.—Their objects and the construction of various types; various rolls, iron, husk, etc.; scutchers, their object and constructions.

Starch Mangles.—The object and construction of all types of starch mangles for pure starch and filled goods; various types of rolls, brass, rubber, wood; action of doctor blades, etc.; regulation and object of pressure.

Methods of starching and finishing all standard goods, also a consideration of the various substances used, such as starch, softener and fillers; the preparation of starch and various methods of application.

Dryers and Stretchers.—Both horizontal and vertical types of drying cans, tenter frames, clips, etc.; the swing motion and the finishes thus produced; object and construction of spraying machines, belt stretchers, short tenters, button breakers, etc.

Calenders.—The object and construction of all types, including the regulation of pressure and nips for the production of various finishes; various types of rolls and their uses,—steel, husk, cotton, paper, etc., the use of hot and cold rolls;

chasing, friction, embossing and Schreiner calenders, and the various finishes produced by each; production of watered effects; beetling machines and hydraulic mangles.

Making-up room,—yarding, inspecting; different types of folds; pressing, papering, marking. [Courses I, III, VI.]

PHYSICAL EDUCATION

All members of the freshman class are required to take a course in physical training conducted in the gymnasium under the direction of an instructor in physical education. Two periods per week for the entire first year are devoted to this work. At the beginning of the year a full record is made of the physical examinations carried on by the instructor and a reputable physician that proper and beneficial exercise may be prescribed.

The object is to give general instruction in the care and strengthening of the body, and to so guide the students that they may continue to give proper thought to their physical training that their mental development may have its greatest effect.

Proper gymnasium clothing is required and all students must take a shower bath following each exercise.

EQUIPMENT

The equipment of machinery, inventoried at $330,850.00, is most varied for textile educational purposes, and is being constantly augmented. The builders of the various machines installed keep in close touch with the Institute, adding to the machines such improvements as are made from time to time, and each year some new machine will be added by a manufacturer who finds it to his advantage to be represented here. This operates to the mutual advantage of student and manufacturer.

Cotton Yarn Department.—The opening and picking section of this department contains a 50-saw Pratt gin used for experimental purposes. For classing work, there is a specially equipped section with north light, where Universal Standard Grades and Government Staple Standards are available.

The picking equipment consists of two Kitson pickers, one 40-inch two beater breaker lapper with an automatic feeder and one 40-inch finisher lapper with a Perham and Davis evener. There is an extra Kirschner patent carding beater to be used in this finisher picker.

The card section has three standard revolving flat top cards, one each from Saco-Lowell, Whitin, and Howard and Bullough shops. One of these is equipped with a Chapman electric neutralizer to prevent trouble from static electricity.

The combing section consists of a sliver lapper, one four-head ribbon lapper, one six-head ribbon lapper, one two-head comb, one six-head comb and one eight-head comb, all from the Whitin Machine Works. There is also one two-head Nasmith comb from John Hetherington and Sons of England.

The drawing frames are all of the single head type. There are two four-delivery drawing frames and one railway head from the Saco-Lowell Shops. One frame is equipped with both common and metallic drawing rolls, electric stop motions and Ermine top roll clearers. The other frame and the railway head both are equipped with metallic rolls and mechanical stop motions. Another frame of two deliveries is from the Howard and Bullough shops. It has electric stop motions and metallic drawing rolls.

The roving section has a complete equipment, slubber, intermediate, fine and jack frame from the Saco-Lowell Shops. In addition, there is an intermediate frame made by the Woonsocket Machine and Press Company, and a fine frame from Howard and Bullough. The last named serves to illustrate the common English construction and how it differs from the American construction as illustrated in the other roving machines.

The spinning equipment is quite varied both with respect to builders and with respect to types and sizes. The Saco-Lowell Shops have supplied five different frames varying from 36 to 216 spindles. They are suitable to spin counts from 3s

to 80s. One is equipped with the LeBlan Roth long draft system, while another has a special five roll long draft system built in the Institute. A sixth Saco-Lowell frame was supplied by the Acme Machine Company equipped with Chapman ball bearing spindles. Four of these frames are equipped with individual motor drives,—one chain drive, one Texrope drive, one gear drive and one Washburn clutch drive. The Whitin Machine Works is represented by three frames on which counts from 3s to over 100s can be spun. One of these frames has an auxiliary equipment of SKF roller bearing spindles and is fitted on one side with Casablanca long draft equipment. The Howard and Bullough shops have one spinning frame suitable for counts from average to fine. This is equipped with an English type of builder which distinguishes it from the other frames. One Fales and Jenks frame is present, equipped on one side with the Casablanca long draft system. This machine is equipped with an individual alternating current motor with a chain drive. One spinning mule has been retained to illustrate this peculiar type of spinning. It is from Asa Lees Company of England and is suitable for counts above 30.

There is one short spooler from the Saco-Lowell Shops. There are two winders from the Foster Machine Company, one for single ends either on cones or tubes, the other for one, two, or three ends parallel wound, especially for preparation for twisting. There is also a one gang Universal No. 50 winder suitable for winding ordinary tubes or Franklin Process packages.

The twisters are suitable for all counts. There is one each from the Saco-Lowell, the Howard and Bullough, and the Fales and Jenks Shops. These are all equipped for either wet or dry twisting of average and fine counts. There are two twisters from the Draper Corporation. These are equipped for wet or dry twisting for coarse counts or heavy plies.

The department has a complete coiler waste system as made by the Saco-Lowell Shops, consisting of a 40-inch single coiler side delivery breaker card; a 40-end derby doubler; a 40-inch four coiler finisher card; a combination slubber-intermediate and a waste spinning frame. This equipment is suitable to spin coarse numbers from cotton wastes to be used in such materials as coarse sheeting, osnaburgs, twine and mop yarns.

To prepare mill wastes for re-use there is one single cylinder roving waste opener and one thread extractor, both from the Saco-Lowell Shops.

With the exception of the opening-picking room the humidity in this department is controlled automatically by a system installed by the American Moistening Company. Seven high duty heads supply the necessary moisture and air circulation. An adjustable automatic control regulates the humidity to the desired per cent.

The experimental laboratory is equipped with a power driven skein tester for determining yarn strength and a Moscrop single thread tester for single end strength. There are twist counters for determining the amount of twist and the twist contraction. For fine work and for fiber study, there is an analytical balance and a Spencer microscope equipped with three objectives, three oculars, ocular micrometer, mechanical stage and Abbé condenser. In addition, there is a gas conditioning oven to use in determining moisture content and regain. A number of scales and balances, together with yarn reels, roving reels and measuring boards make up the equipment for routine mill sizing tests.

Knitting Section.—The winders for this section include a six-spindle Universal winder for cones and tubes and a Payne bobbin winder.

The machines in the following group are equipped with special attachments for producing high splicing, double soling and striped work. The hosiery machines include two Acme full automatic, one arranged for 160 needles and the other for 200 needles; also a Mayo Model C full automatic arranged for 220 needles. Scott & Williams have placed in this section four of their machines, Models B-5, K, HH and RI. There are three Banner machines, all full automatic, two of which are arranged for 220 needles each and one arranged for 160 needles. There is one Brinton full automatic arranged for 176 needles and one Branson hand machine arranged for 80 needles. For hosiery legs and tops there are five ribbers, made by the Wildman Company, with cylinders varying from 3½–5¼ and arranged for needles varying in number from 160–240; two Brinton ribbers, one arranged for 176 needles and the other 200 needles; one Brinton tie machine, 1¾-inch cylinder

100 needles and 49 needles; one Universal Ribber $3\frac{1}{2}$-inch diameter, 160 needles. To illustrate the fully fashioned type of knitting hosiery there is an 18 section, 39 gauge Reading legger, with topping stand.

The underwear machinery consists of one Crane spring needle machine, one Scott & Williams ribber, and one Wildman ribber.

Under the group of flat machines there are three Lamb machines, one arranged for knitting gloves and one arranged for knitting sweaters. In addition to these there is also a Grosser sweater machine, a Jacquard machine, and a link and link machine; a Dubied scarf machine; and a Raschel warp knitter.

For finishing work this section includes a Grosser 2-thread looper, one Hepworth looper, two Beattie loopers; five Union special sewing machines for overseaming, double stitch covering, seaming and welting and vest finishing; six Merrow sewing machines, including two shell stitch machines and three overseaming and crocheting machines; three Singer machines; three Wilcox & Gibbs sewing machines, including a flat lock machine.

The Philadelphia Metal Drying Form Company has installed a table of six forms including men's, women's and children's.

For instruction in the manufacture of braids the New England Butt Company has installed one 24-line Hercules braider, one 12-line braider, one tubular braider, and one soutache braider.

Woolen Yarns Division. — The following machinery and equipment is available for use in the manufacture of yarn on the woolen principle.

Installed by Davis & Furber Machine Company of North Andover, Mass.: One wool mixing picker equipped with hopper feed (George S. Harwood & Son) and Spencer wool oiler; one modern set of 60x40 woolen cards, garnet breast, single cylinder breaker, two cylinder finisher with improved Bramwell feed (by Harwood & Son); Broadbent Davis and Furber intermediate feed, 80 end single apron tape condensers and all change gears; one set woolen cards 48x40 with breaker, intermediate and finisher cylinders; Bramwell-Harwood weighing feed, Bates-Apperly-Harwood intermediate feeds, 40 end ring doffers with two apron condenser; one 120 spindle spring mule with bobbin holders by the American Bobbin Holder Company; one mule headstock mounted on trucks for instruction purposes; one fancy yarn twister with chain and gear equipment; one filet winding drum stand with tension bars, wind, etc., for applying card clothing.

Installed by C. G. Sargent's Sons Corporation, Graniteville, Mass.: One multiple burr picker for medium wools, one yarn conditioning machine with motor drive.

Installed by Johnson and Bassett, Inc., of Worcester, Mass.: One 120-spindle cam mule complete; one mule headstock mounted on trucks for instruction purposes.

Installed by Torrance Manufacturing Company: One samole mixing card for blending and matching wool.

Installed by B. S. Roy & Son, Worcester, Mass.: One card grinding stand with two traverse grinders complete.

Equipment: Modern ferrule type fiber head jack spools and bobbins by U. S. Bobbin and Shuttle Company of Lawrence; yarn baskets by Steele Supply Company, Cambridge, Mass.; hand cards by Howard Brothers of Worcester and Davis & Furber Machine Company.

Shoddy or Reworked Fiber Division. — Installed by C. G. Sargent's Sons Corporation: One cypress screw acid dip tank; one single apron dryer (baker); one cone carbonizing duster with crush rolls.

Installed by Schaum & Uhlinger, one steam hydro-extractor.

Installed by C. S. Dodge of Lowell, one ball bearing rag picker with condenser, one bagging stand.

Installed by John T. Slack Corporation are hundreds of samples of reworked wool in all stages from rags to fiber.

Wool Preparing Division. — Wool sorting and grading is carried on under excellent conditions with the following equipment: sorting bench, baskets, bagging stands, etc.

Installed by C. G. Sargent's Sons Corporation: One cone grease wool duster, one four bowl scouring train with large hopper feed; one single apron dryer with large feeder.

Top Making Division. — Top for the Bradford or French system is made with the following machinery: One double cylinder worsted card (four licker-in) with Bramwell feed, can coiler and balling head complete by Davis & Furber Machine Company. An electric neutralizer is furnished on card by the Chapman Electric Neutralizer Company. This section also includes a double bowl, 5-cylinder back-washer, with gill box, Taylor-Wordsworth & Co., Leeds, England, equipped with blueing motion, oiling motion, and Layland patent pressure motion; a weigh gill box and creel and one doubling balling head gill box (with double screws) made by the Saco-Lowell Shops of Lowell, Mass.; a worsted comb with baller punch made by Crompton & Knowles, Worcester, Mass.; two finishing gill boxes, one known as a can gill box and the other a balling head gill box, both made by Hall & Stell Keighley, England.

Worsted Yarn Division. — Bradford or English System: For the manufacture of yarns under the Bradford System of Drawing, Spinning, and Twisting, the following machinery as made by Prince Smith & Son, Keighley, England, make up the equipment: one revolving creel for 12 balls, one 2-spindle drawing box, one 4-spindle first finisher, one 12-spindle dandy reducer, one 12-spindle cap spinner, one double head can gill box, one 2-spindle gill box, one 2-spindle flyer spinner, one 12-spindle ring spinner, one 12-spindle 2-fold cap twister, one 12-spindle 6-fold ring twister. In addition to this the Saco-Lowell Shops, Lowell, Mass., have installed the following machinery to carry on similar work: one 2-spindle drawing box, one 6-spindle second finisher, one 24-spindle dandy rover, one 6-spindle cone reducer, one 8-spindle cone rover, one 48-spindle cap spinner, 5-foot end, one 48-spindle cap spinner, 4-foot end, one 48-spindle Boy ring twister. The Universal Winding Company has installed one of its 6-gang winders, equipped for cones or straight tubes. The Lindsay-Hyde Company has installed a modern skein winder.

The humidity in the laboratory of the woolen yarns and of the English system of worsted yarns is maintained by the American Moistening Company's system through its automatic control. In this laboratory are installed six humidifiers and four Comin's High Duty heads, which are supplied from an electric-driven triplex power pump located in the power house. This same pumping equipment supplies the American Moistening Company's humidifiers operating in the Cotton Yarn Department.

French System. — For the manufacture of worsted yarns under the French System of Drawing and Spinning the machinery has been made by the Société Alsacienne de Constructions Mechaniques, Mulhouse, France, and the equipment consists of the following: Model P. L. B. comb with creel for 24 doublings, intersecting gill box (2 heads), gill box (2 heads), first drawing (2 heads), second drawing (2 heads), third drawing (2 heads) reducer (4 porcupines), slubber (8 porcupines) first intermediate (8 porcupines), second intermediate (8 porcupines) rover (8 porcupines), finisher (16 porcupines), self-acting worsted mule (150 spindles).

The Saco-Lowell Shops built and installed a ring spinning frame of 60 spindles for worsted yarns equipped with individual General Electric Company's motor and a Reeves Variable Speed Transmission.

Twelve turbo humidifier heads automatically controlled by a humidity regulator have been furnished by the G. M. Parks Company, Fitchburg, Mass. The compressed air for these heads is supplied by an Ingersoll-Rand 8 by 8 steam-driven air compressor.

Textile Testing Division. — Complete equipment is available for testing all kinds of fibers and fabrics under controlled conditions for breaking strength, elasticity, elongation, physical structure, moisture content, oil content, thickness, bursting strength, count of yarn, yards per pound, twist, resistance to abrasion and other tests of commercial or experimental importance. This equipment includes the necessary microscopes and micrometers, a skein-testing machine, and electric conditioning oven made by the Emerson Apparatus Company of Boston; single yarn and fabric strength-testing machines made by G. R. Smith & Company, Bradford, England; a strength-testing machine, capacity 500 kilograms, for testing twines and fabrics; a fiber-testing machine for testing fibers and fine yarns with capacity, 1 gram to 1.5 kilograms; a yarn strength-testing machine with capacity 1,000 to 5,000 grams; and a yarn strength testing machine with capacity 5 to 30

kilograms, all of which have been made by Louis Schopper, Leipzig, Germany. In addition to these there is a standard yarn and fabric testing machine as made by Henry L. Scott & Company of Providence, R. I., a Mullen Tester, a special abrasion machine for testing the resistance to wear of carpets and other pile fabrics, also an abrasion machine for testing resistance to wear of twines, tapes, and all stripped flat fabrics. For the automatic control of temperature and humidity there has been installed by the American Moistening Company, of Boston, one of its automatic humidity and temperature regulators.

Design and Power Weaving Department.—In the fabric analysis section there has been provided chemical balances made by Voland & Sons and Christian Becker, necessary twist testers, microscopes, reels, etc., as well as a Torsion calculation balance made by the Torsion Balance Company of New York.

In the warp preparation department there has been installed by the Saco-Lowell Shops one of its spoolers, besides a slasher for preparing cotton warps; a high speed warper, by T. C. Entwistle Company of Lowell. The Whitin Machine Company, Whitinsville, Mass., has supplied a 180-spindle, long chain quiller, and the Johnson & Bassett Company, Worcester, Mass., a quiller of its make. The Universal Winder Company has supplied a winder for cop and bobbin winding and an 8-spindle doubler. Also a winder for the high speed warper.

The woolen and worsted warp preparation department contains two 40-end Jack spoolers, two spool racks for 12 spools each, one pattern dry frame dresser, one pipe and cylinder dresser, one 60-inch reel, one 82-inch reel, and one double head beamer, all supplied by the Davis & Furber Machine Company of North Andover, Mass.

The Weaving Department contains four looms supplied by the Draper Corporation of Hopedale, Mass., which include a plain Northrup, an 8-harness corduroy, an improved Northrup, a Northrup with dobby. The Stafford Loom Company of Readville, Mass., has installed one plain, one cam, one dobby loom and one broad sheeting loom, all equipped with individual motors; the Whitin Machine Works, Whitinsville, Mass., a side cam twill, a plain print cloth loom, equipped with Kip-Armstrong electric warp stop motion; Crompton & Knowles Loom Works a jean loom and a plain loom with individual drive. Four of these looms are equipped with Abbott cleavers made by the Abbott Wire and Cast Steel Warp Cleaving Company, Lisbon Falls, Maine. The Hopedale Manufacturing Company of Milford, Mass., has recently installed one of its high speed looms with individual motor.

The fancy loom section includes a Stafford Ideal 16-harness automatic shuttle-changing loom, a Whitin 20-harness dobby loom, and the following furnished by the Crompton & Knowles Loom Works: Knowles gingham 4 by 1 boxes, Crompton gingham 4 by 1 boxes, one Crompton towel 2 by 1 boxes, two Terry towel and one huck towel looms, a 16-harness lappet loom, a 20-harness dobby 4 by 1 boxes, fancy leno loom, and a Crompton fancy cotton single cylinder 20-harness dobby.

The woolen and worsted section contains a Knowles 20-harness Gem, a Crompton 24-harness worsted 4 by 4 boxes, a Crompton 6 by 1 double cylinder 20-harness dobby, one heavy 20-harness 4 by 4 boxes, one 20-harness and one 25-harness blanket, seven intermediate woolen 25-harness 4 by 4 boxes and two 90-inch 25-harness heavy woolen looms.

The Jacquard loom section includes one Stafford silk loom, 1,200-hook, Halton head; one 400-hook, single-lift Schaum & Uhlinger Jacquard, mounted for 4-bank, narrow fabric loom; one Skinner Brussels carpet loom, three-quarters wide, equipped with 1,280-hook Jacquard head presented by the Bigelow-Hartford Carpet Company, Clinton, Mass. The Crompton & Knowles Loom Works has furnished one Knowles fancy loom, single-lift Jacquard; one Knowles fancy loom, double-lift Jacquard; one Knowles fancy loom, Jacquard tied up for leno, one Knowles loom, 4 by 4 boxes, 54-inch, with 600-hook, double-lift, double-cylinder McMurdo Jacquard head, tied up for damask napkin designs; one Crompton & Knowles 72-inch tapestry loom, with 2,600-hook Halton Jacquard head, one 840-hook, double-lift, single-cylinder Jacquard on Crompton & Knowles 4-bank ribbon loom, one 800-hook, double-lift Knowles Gem silk brocade Jacquard machine, 4 by 4 boxes.

The silk loom section includes one Stafford silk loom, 20-harness dobby, 2 by 1 box motion, sliding bar warp stop motion, filling feeler, extended beam stands motor drive; one Crompton & Knowles silk loom, 4 by 4 box motion, 20-harness head motion, individual motor drive.

For the purpose of card cutting there has been furnished one Jacquard fine index card-cutting machine by John Royle & Sons, Paterson, N. J.; one Jacquard French index card-cutting machine by the same concern.

Chemistry and Dyeing Department.—The Chemistry Laboratory consists of one to give instruction in General Chemistry and Qualitative Analysis and provides facilities to take 120 students. The Quantitative Laboratory takes care of some 50 students and contains the necessary drying closet, steam bath, electrolytic table, with ample facilities to provide distilled water through the use of a Barnstead Water Still. The Balance Room, which is adjacent to the laboratory, has eleven analytical balances made by such concerns as Christian Becker, Eimer & Amend, and H. L. Becker's Sons & Company. The Organic Laboratory has facilities to take care of approximately 25 students having the necessary equipment required in the preparation of basic organic compounds and instruments used in the manufacture of dyes such as autoclaves, electric and gas combustion furnaces.

For the purpose of carrying on photographic and microscopic experiments and analyses the laboratory has been provided with equipment which includes besides the Bausch & Lomb microscopes, a polariscope made by Franz Schmidt & Haensch, Berlin, Germany, a Gaestner spectroscope, a Bausch & Lomb Model G photomicrographic apparatus equipped with D. D. S. microscope and all necessary apparatus, a Kodak projection printer. Besides the common gas and electric lamps there is installed a solar determinator, made by the Atlas Electric Company, Chicago, Ill., also a 400-watt Nela Trutint and color-matching unit made by Nela Specialties Division, Cleveland, Ohio.

The Chemical Museum has been provided with cases and representative dyestuffs all furnished by various dyestuff manufacturers of this country and abroad. This offers an unparalleled opportunity for students to study and experiment with almost all of the representative dyes which are used in the textile industry.

The Experimental Dyeing Laboratory is equipped with individual benches, small dyeing apparatus, reels, balances, apparatus for dye testing, such as frames for exposing dyed material to light, and a complete collection of dyestuff samples and sample cards. There are also fifty-six steam coil experimental dyeing baths, a drying chamber and ageing chamber, in addition to a Hurricane Dryer, Class D, made by the Philadelphia Drying Machinery Company, Pennsylvania. Adjacent to the Experimental Dyeing Laboratory there has been provided a well-lighted room for the storage of a great variety of dyestuffs. Steel shelving has been arranged so that the samples are easy of access. All samples are catalogued in a card file, thus facilitating their use.

The Experimental Printing Laboratory is equipped with a power driven calico printing machine, made by Rice, Barton & Fales, Worcester, Mass., an iron-jacketed steaming chamber, and a set of steam jacketed copper kettles.

The Fuel and Oil Analysis Laboratory contains the following equipment for the analysis of coals and fuels: a Mather bomb calorimeter, an Emerson bomb calorimeter, a Parr calorimeter, an Abbé refractometer, a Torsian and a Tagliabue viscosimeters, a Tagliabue cold test apparatus, a Pensky Martin oil tester, a New York State oil tester, a Sartorius specific gravity balance, two Becker analytical balances, gas muffle furnace, Kny-Scherer oil tester, a Graefe gas calorimeter, an Orsat gas analysis apparatus, laboratory tables, lockers, and hoods.

The Industrial Chemistry Laboratory contains the following: one filter press, Type E. T. Shriver & Company; a single-acting triplex plunger pump, Goulds Manufacturing Company; a vacuum drying apparatus, a surface condenser, a Packard vacuum pump, Norman Hubbard's Sons; a vacuum evaporator, Swenson system, American Foundry and Machine Company; a centrifugal, C. H. Chavant & Company; a double jar mill, F. I. Stokes & Company.

To give instruction in dyeing on a basis which is more comparable with commercial practice there is provided a laboratory which includes the following equipment: a small kier, fitted with E. D. Jefferson's circulating device, a Permutit filter, the Permutit Company, New York City; a mercerizing machine, raw stock and yarn dyeing machines, Klauder-Weldon Dyeing Machine Company; a jig dyeing machine, the Textile-Finishing Machine Company, Providence, R. I.; a set of drying cans by the same concern; a chain dyeing machine, T. C. Entwistle Company, Lowell, Mass.; a raw stock drying table, Proctor & Schwartz, Philadelphia, Pa.; a padding mangle, Arlington Machine Works, Arlington, Mass.; a hydro-extractor, W. H. Tolhurst & Son, Troy, N. Y.; a Psarski experimental dyeing machine, a Hussong experimental dyeing machine, equipped for raw stock or yarns, a Rodney Hunt sample piece dyeing machine, equipped with an automatic temperature and pressure-regulating apparatus, made by C. J. Tagliabue Manufacturing Company, Brooklyn, N. Y. The Franklin Process Company, Providence, R. I., have furnished a 25-pound bronze dyeing machine. Of the various dye tubs, one is equipped with a Monel metal lining to withstand the action of various chemicals and dyes.

Finishing Department.—The Woolen and Worsted section includes a 4-string washer, a fulling mill, and a combination fulling and washing mill for jersey fabrics, furnished by the Rodney Hunt Company, Orange, Mass.; a sample fulling mill, a kicker mill, furnished by James Hunter & Company, North Adams, Mass.; an up and down dry gig, a rolling and stretching machine, an up and down wet gig, a steam finishing machine, a 60-inch, 3-burner singeing machine, adapted for cotton, silk or worsted goods, a 2-cylinder double-acting brushing machine. Curtis & Marble Machine Company of Worcester has furnished a 60-inch 4-cylinder sanding and polishing machine; a mantle steaming and air cooling machine, equipped with a direct connected motor and a Nash pump; and a 66½-inch motor driven, single woolen shear, equipped with list saving motion; a 6-4 double shear, an A. W. C. measuring and weighing machine, furnished by Parks & Woolson, Springfield, Vt.; a dewing machine, a 6-4 Voelker rotary press, furnished by G. W. Voelker & Co., Woonsocket, R. I.; a tentering and drying machine furnished by John Heathcote, Providence, R. I., a single crabbing machine, H. W. Butterworth & Son, Philadelphia, Pa.; a 72-inch woolen napper donated by Davis & Furber, North Andover, Mass.; a 32-inch basket hydro-extractor, W. H. Tolhurst, Troy, N. Y.; a Lintz & Eckhardt cloth numbering machine, from Durbrow & Hearne Company, New York; a steam press for underwear, United States Hoffman Company, Syracuse, N. Y.; a sewing machine, Birch Brothers, Somerville, Mass.; a trimming and overseaming machine, The Merrow Machine Company, Hartford, Conn.

The Cotton section includes a 40-inch inspecting and brushing machine, a 44-inch No. 25 railway sewing and rolling machine, a 44-inch cotton shearing machine, Type No. 34, a 44-inch No. 3 steam calender rolling machine, a 40-inch cloth folder, a 40-inch winder and measurer, a set of 44-inch shear blades for grinding purposes, furnished by Curtis & Marble Machine Company, Worcester, Mass.; a 48-inch No. 4 opening, sewing and rolling machine, a No. 1 hand power portable railway sewing machine, furnished by Dinsmore Manufacturing Company, Salem, Mass.; a 40-inch 4-tank open soaping machine equipped with patent flushing rolls, brass and rubber squeeze rolls and spiral openers, furnished by Birch Brothers, Somerville, Mass.; an 84-inch 36-roll, ball bearing, double acting napper, equipped with a 7½-horsepower General Electric motor drive, furnished by Davis & Furber, North Andover, Mass. (the ball bearings were donated by the Fafnir Bearing Company, New Britain, Conn.); an 8-inch belt lacer furnished by the Clipper Belt Lacer Company of Grand Rapids, Mich.; a 40-inch, 3-roll water mangle, with husk and brass rolls and usual attachments and equipped with a 48-inch Mycock scutcher, and a 40-inch Mycock cloth expander made by Thomas Leyland & Company, Boston; a 40-inch, 2-roll starch mangle, a 40-inch upright drying machine with 10 copper cylinders equipped with Files dry can system, Files Engineering Company, Inc., Bridgeport, Conn.; a 40-inch sprinkler, a 40-inch, 5-roll Universal calender with chasing attachment and equipped with a 40-inch Mycock cloth expander, a pasting table with plate, furnished by the Textile-Finishing Machinery Company, Providence, R. I.; a 16 by 24 inch bronze-covered stretcher for the

drying cans, C. A. Luther & Company, Providence, R. I.; a 40-inch double bristle stretcher for drying cans, American Finishing Machinery Company, Boston, Mass.; a trimming and overseaming machine, The Merrow Machine Company, Hartford, Conn.; a 40-inch Tommy Dodd starch mangle, and a 44-inch, 50-foot vibratory tentering machine, H. W. Butterworth & Sons Company, Philadelphia, Pa. This machine is directly driven by a 7½-horsepower variable speed motor and is equipped with a Schwartz automatic electric guider, made by L. H. A. Schwartz & Company, Boston, Mass.

Engineering Department.—The Steam Engineering Laboratory contains the following equipment arranged for experimental purposes: A 50-horsepower Allis-Chalmers Corliss steam engine direct connected to an Alden absorption dynamometer, and piped to exhaust its steam to the atmosphere, to a Wheeler surface condenser or to the Kerr turbine; a Kerr seven-stage turbine driving directly a 25-kilowatt Richmond Electric Company's alternating current generator and piped to exhaust either to the atmosphere or the condenser. It may be operated either as high pressure or low pressure turbine, and the generator has special connections to illustrate various commercial phases. In addition there are a 4 by 6 Deane triplex power pump, two 2-inch centrifugal pumps made by Lawrence Machine Company, Lawrence, Mass., a Clayton air compressor and necessary tanks, scales and measuring instruments. For the measurement of flow of air there are a steam-driven Sturtevant fan and a motor-driven Massachusetts fan with heater combined for heating and drying experiments.

The Electrical Engineering Laboratory consists of two sections, one of which is devoted to instruction in the generation and transmission of power, and contains the necessary switchboard and instruments to control a 25-kilowatt alternating current turbo generator and a 15-kilowatt motor generator set arranged to supply either direct or alternating current. In addition there are a 24-horsepower direct current Allis-Chalmers motor and a 10-horsepower direct current General Electric motor, also a 10 and a 7.5 horsepower General Electric alternating current motor besides a General Electric 3-kilowatt rotary transformer and three Westinghouse stationary transformers. The other section of the laboratory is known as the instrument laboratory and is for the purpose of giving instruction in the measurement of current voltage, resistance, and in the calibration of instruments. It contains a 5-kilowatt Crocker-Wheeler balancer, a 160-ampere hour storage battery, a 5-kilowatt 220-volt to 440-volt General Electric transformer, a Westinghouse portable wattmeter with current and potential transformers, three wattmeters, two ammeters and a voltmeter, all of the General Electric portable alternating current type, a 30-volt alternating current Roller Smith voltmeter, a 5 to 10-scale Weston ammeter (electro-dynamometer type), a Weston millivoltmeter with 2, 20, 50 and 200 ampere shunts, three 250-volt direct current Weston voltmeters, a 150-ampere, two model, 45 two model 260 Weston portable ammeters, a Weston model 260 voltmeter, a Thompson 50-ampere recording wattmeter, a General Electric rotating standard wattmeter, two General Electric induction type watt hour meters, an Esterline portable curve drawing wattmeter, a 100-ampere Leeds & Northrup Standard Resistance, a Leeds & Northrup Ayrton shunt, a Weston laboratory standard voltmeter with 600-volt multiplier, a Leeds & Northrup potentiometer, a D'Arsonval wall type galvanometer, a Wheatstone bridge with galvanometer, a slide wire bridge and electro-dynamometer, Weston Standard cell, potential phase shifter, a standard Leeds & Northrup photometer with Lummer-Brodhun screen, and Macbeth illuminometer made by the same concern.

Machine Shop.—The equipment of the machine shop is as follows: Four standard engine lathes, 13-inch swing, 6-foot bed, and an engine lathe, 18-inch swing, 10 foot bed; three standard engine lathes, 14-inch swing, 6-foot bed, rom Flather & Company, Nashua, N. H.; a standard engine lathe, 15-inch swing, 6-foot bed, from F. E. Reed Company, Worcester, Mass.; an engine lathe, 18-inch swing, 6 foot bed from Champion Tool Works, Cincinnati, Ohio; a standard engine lathe, 15-inch swing, 6-foot bed, from S. H. Putnam Sons, Fitchburg, Mass.; one No. 1 Universal milling machine, with all three feeds automatic, from Kempsmith Manufacturing Company, Milwaukee, Wis.; one 24 by 24 inch, 6-foot planer, from the Mark Flather Planer Company, Nashua, N. H.; one 23-inch upright drill, with back gears and power feed, from J. E. Snyder & Son, Worcester, Mass.; one

14-inch single sensitive drill, from the Stanley Manufacturing Company, Lawrence, Mass.; one No. 1 Universal grinder, from Landis Tool Company, Waynesboro, Pa.; five speed lathes, 17-inch swing, 5-foot bed, one 20-inch wet tool grinder, and one 12-inch, 2-wheel dry grinder, from J. G. Blount, Everett, Mass.; an American twist drill grinder, from the Heald Machine Company, Worcester, Mass.; one Type 1B portable electric grinder from the Cincinnati Electric Tool Company, Cincinnati, Ohio; one 30-inch grindstone and frame, from the Athol Machine Company, Athol, Mass.; a single spindle centering machine, from D. E. Whiton Machine Company, New London, Conn.; one 15-inch shaper, from Potter & Johnson, Pawtucket, R. I.; one power hacksaw, from the Fairbanks Company, Boston, Mass.; one cold saw, from John T. Burr & Son, Brooklyn, N. Y.; one Eureka metal power saw, Manning, Maxwell & Moore; one Type CC electric drill, Cincinnati Electric Tool Company; one Universal milling attachment for Kempsmith milling machine, and one Hisey Type B ½-horsepower tool post grinder, Taylor Machinery Company; one No. 2 Cory bench straightener, Manning, Maxwell & Moore; one No. 3 Universal cutter and reamer grinding machine, Browne & Sharpe; a well-equipped tool room containing a selected stock of the best makes of small tools, such as drills, taps and dies, milling cutters, reamers, gauges, micrometers, etc.

Power, Light, Heat and Ventilating Plant.—In the powerhouse there is located the main power-generating apparatus for supplying light, heat and power to all departments of the Institute. The equipment here consists of: two 250-horsepower Heine water tube boilers, one equipped with a Jones stoker and one with Perfection grate, a 300-horsepower Aultman & Taylor horizontal water tube boiler, equipped with United States rocking grates, two boiler feed pumps—one a Knowles and the other a Deane—a 40,000-pound Cochrane metering open-feed heater, which is provided with a Lea recorder, and a Cochrane oil extractor heats and measures all feed water, a 3-inch Venturi meter in feed line with indicating manometer as made by the Builders Iron Foundry, Providence, R. I. In the Engine Room are located: a Payne 14 by 14 automatic high speed engine, 125-horsepower direct connected to 75-kilowatt, 220-volt, direct-current Bullock generator, a 9½ by 11 Nash gas engine of 50-horsepower, 4-cycle type, direct connected to a 30-kilowatt, 220-volt, direct-current Bullock generator, a 65-kilowatt motor generator set, consisting of a direct current motor and an alternating current generator made by the Westinghouse Electric and Manufacturing Company. A steam-driven Ingersoll-Rand 8 by 8 air compressor, for use with Turbo heads, installed in the French Spinning Department by the G. M. Parks Company, Fitchburg, Mass. The station switchboard is of marine-finished slate, 90 inches in height, and consists of three generator panels and two circuit panels.

The powerhouse is connected with the main school buildings by a tunnel through which all wires, steam and water pipes are carried.

GRADUATES WITH TITLES OF THESES

June 9, 1931

Bachelor of Textile Chemistry

Edward Joseph Allard, Lowell, Mass. "The Analyses of Compounds Used in the Textile Industry."

Alfred John Carbone, Haverhill, Mass. "The Isolation and the Identification of Certain Organisms from Mildew."

Francis Harold Casey, Roslindale, Mass. "A Comparison of the Dyeing Properties of Mordant Acid Dyes when Dyed by the Mordant Acid, Chromate, and Mordant Processes."

Arthur Joseph Danahy, Lowell, Mass. "Use of the Densometer in the Textile Industry."

Paul Curran Duggan, Lowell, Mass. "The Decomposition of Hydrogen Peroxide."

Wallace Howe French, Lowell, Mass. "Color Reactions as a Means of Identifying Indigosol Dyes on Wool."

Ralph Edgar Hale, West Newbury, Mass. "Effects of Time and Tension on Mercerization."

Stanley Arundel Hall, Haverhill, Mass. "A Study of the Chemistry of the Aftertreatment of Mordant Acid Dyes. Other Metals which can be Used beside Chrome—the Part Oxygen may Play."

Frank Barbour Hosmer, Lowell, Mass. "The Effect of Bacillus Subtilus on the Strength of Cotton."

Gerald Anthony Ivers, East Chelmsford, Mass. "A Study of the Effect of Dyeing Viscose under Tension."

Julius Jarek, Lowell, Mass. "The Aftertreatment of Direct Cotton Dyes with a Study of the Relative Fastness Obtained."

Norman Albin Johnson, Deep River, Conn. "A Determination of that Moisture Content at which Bacteria will have the Greatest Damaging Effect on Cotton."

Abraham Lifland, Fall River, Mass. "The Bleaching of Tussah Silk."

Gordon Algeo McAllister, North Billerica, Mass. "A Study of Some Reactions in the Anthraquinone Group of Compounds."

Margaret Mary Maher, Lowell, Mass. "A Study of the Results Obtained in the Use of Tannic Acid and Katanol O as Mordants for Basic Dyes on Cotton so as to Determine the Relative Fastness to Washing and to Light of Such Dyes."

John George Parker, Jr., Chelmsford, Mass. "The Relative Rapidity with which Various Sulphur Dyes Oxidize and the Bearing that this may have on Heavily Dyed Selvedges."

Eric Arthur Peterson, Lowell, Mass. "Carbonization: A Study of the Chemistry Involved and the Causes of Irregularities in Its Commercial Operation."

Gerald Francis Quigley, Lowell, Mass. "The Effect of Alkalies on Cellulose Acetate Rayon."

Joseph Max Wallace, Malden, Mass. "Dyeing Possibilities of a Mixture of Wool, Cotton, Viscose, and Acetate Rayon."

Bachelor of Textile Engineering

William Swanton Bradford, Andover, Mass. "A Study of Tensile and Bursting Tests of Textile Fabrics."

Joseph Frederic Burtt, Lowell, Mass. "A Determination of the Relationship Between the Strength and Regain of Worsted Fabrics.

Everton Hanscom Loveless, Melrose, Mass. "A Determination of the Effect of Twist upon the Strength and Elasticity of Rayon Yarns."

Richard William Rawlinson, Lowell, Mass. "Measurement of Tension in Cotton Roving and Spinning Operations and Its Autographic Recording."

Alexander Stewart, Andover, Mass. "An Investigation of the Possibility of Using the Vengraph to Measure the Absolute Moisture Content in Fabrics."

Yun-Cheng Wang, Shanghai, China. "A Study of the Light Regularly Reflected from Textile Fabrics and Its Relation to their Luster."

Diploma Graduates

Cotton Manufacture

John Joseph Kilmartin, Lowell, Mass. "The Effect of Processing Cotton with the Fibres Continually Drawn in the Same Direction."

Wool Manufacture

Charles Wilkes Babb, Jr., Camden, Maine. "The Manufacture of Woolen Top Coat Fabric."

Richard Omer Pero, Methuen, Mass. "The Manufacture of Woolen Top Coat Fabric."

Textile Design

John Ervin Peary, Wilton, Maine. "Color Combinations in a Designer's Worsted Blanket."

Prizes awarded in June, 1931

The Medal of the National Association of Cotton Manufacturers awarded to the student taking course in Cotton who maintains the highest average in scholarship throughout this course. To *John Ervin Peary.*

Louis A. Olney Prizes (in the form of books).

$20 to the regular student in the Chemistry and Textile Coloring course who shall present the best thesis preparatory to graduation. To *Ralph Edgar Hale.*

$10 to the regular student of the Chemistry and Textile Coloring course who shall be considered as having attained the highest scholarship during his second year. To *Raymond Lewis Matthews.*

$5 to the regular student of the Chemistry and Textile Coloring course who shall be considered as having attained the second highest scholarship during his second year. To *Gerald Adelbert Robillard.*

$10 to the student taking the regular Chemistry and Textile Coloring course who shall be considered as having attained the highest scholarship in first-year Chemistry. To *Robert Joseph Thomas.*

$5 to the student taking the regular Chemistry and Textile Coloring course who shall be considered as having attained the second highest scholarship in first-year Chemistry. To *Robert Theodore Graham.* Honorable mention, *Kenneth Everett Leslie* and *Leon Eugene Moody.*

Scholarships

The Textile Color Card Association Scholarship.—For the purpose of promoting interest in color harmony and color blendings for textile material, this association offered in June, 1930, a scholarship providing free tuition to a member of the class of 1932, the scholarship to continue for two years in accordance with specified conditions named in the offer. Awarded to *Edward Lucien Golec.*

REGISTER OF DAY STUDENTS

Candidates for Degree

Class of 1932

Home Address	Lowell Address
Bagshaw, Herbert Arthur, VI, Dracut, Mass.	———
Barry, Marie Gertrude, IV, Lowell, Mass.	31 Hoyt Avenue
Bertrand, Arthur Leon, IV, Lowell, Mass.	27 West 5th Street
Campbell, Allan, Jr., VI, South Boston, Mass.	37 Varney Street
Ferguson, Thomas Dickson, Jr., VI, Lowell, Mass.	Omicron Pi House
Gleklen, Leo, IV, Lynn, Mass.	37 Butterfield Street
Glowacki, Joseph, VI, Andover, Mass.	———
Hardman, Joseph Edwin, IV, Lowell, Mass.	51 Westchester Street
Hegy, Gerard John, VI, Holyoke, Mass.	106 Crawford Street
Hockridge, Stanley Squire, IV, North Adams, Mass.	Omicron Pi House
Howard, Lorne Fernley, IV, North Chelmsford, Mass.	———
King, Daniel Joseph, IV, Lowell, Mass.	158 Pleasant Street
Lathrop, John Dunn, IV, Lowell, Mass.	37 Varney Street
Lifland, Bessie, IV, Roxbury, Mass.	———
McDonald, John Joseph, Jr., IV, Lowell, Mass.	208 Mount Hope Street
McDougall, Francis Gerard, VI, Lowell, Mass.	637 Broadway
McQuaid, Barton Mathewman, IV, North Billerica, Mass.	———
Meehan, John Joseph, IV, Lowell, Mass.	35 Varney Street
Meinelt, Herbert Eugene, IV, Lawrence, Mass.	———
Moran, Edward Francis, IV, Lowell, Mass.	75 Beacon Street
Orlauski, Anthony, IV, Haverhill, Mass.	———
Piligian, Hiag Nishan, IV, Springfield, Mass.	37 Varney Street
Pizzuto, Joseph James, Jr., IV, Pittsfield, Mass.	65 Sterling Street
Russell, Harold William, VI, Sanford, Maine	7 Sanborn Street
Sawyer, Henry Severance, VI, Dalton, Mass.	———
Spalding, Arthur Ovila, IV, Lowell, Mass.	84 D Street
Toher, Francis Luke, IV, Lowell, Mass.	524 Moody Street
Walker, Samuel J., IV, East Liverpool, Ohio	37 Varney Street
Wojas, Stanley Edward, IV, Lowell, Mass.	24 Ray Court

Class of 1933

Armitstead, Russell Arthur, IV, Lowell, Mass.	628 Wilder Street
Babigan, Edward, IV, Lowell, Mass.	121 Bellevue Street
Birtwell, John Lincoln, IV, East Chelmsford, Mass.	———
Churchill, Charles Whittier, Jr., VI, Lowell, Mass.	214 Third Street
Custer, Herbert James, IV, Lowell, Mass.	4 Hildreth Street
Daley, Charles Lincoln, IV, Lowell, Mass.	239 Stevens Street
Dempsey, Philip Edward, IV, Monson, Mass.	Phi Psi House
Donohoe, Edward Joseph, VI, Lowell, Mass.	49 Butterfield Street
Dudley, Albert Richard, VI, Lowell, Mass.	126 Coburn Street
Echecopar, Jesús Fortunato, VI, Lima, Peru	11 White Street
Forsythe, George, VI, Andover, Mass.	———
Gifford, Alden Ives, VI, Lowell, Mass.	18 Marlborough Street
Glowienski, Mitchell, IV, Lowell, Mass.	198 West Sixth Street
Hallissy, John Joseph, VI, Manchester, Mass.	Phi Psi House
Kokoska, Michael George, VI, Lowell, Mass.	120 Lakeview Avenue
Lifland, Moses, VI, Roxbury, Mass.	———

Markarian, Haig, IV, Lowell, Mass.	103 Lawrence Street
Matthews, Raymond Lewis, IV, Gardner, Mass.	Omicron Pi House
Murphy, John Joseph, IV, Lowell, Mass.	124 Liberty Street
Raymond, Frank Everett, Jr., VI, Salem, Mass.	———
Recher, Theodore, VI, North Providence, R. I.	Phi Psi House
Robillard, Gerald Adelbert, IV, Lowell, Mass.	124 Riverside Street
Savard, Aimé Albert, IV, Lowell, Mass.	311 Mammoth Road
Shapiro, Simon, VI, Lowell, Mass.	84 Cambridge Street
Stearns, Kenneth Lawrence, IV, Lowell, Mass.	43 Grace Street
Turcotte, David Henry, IV, Lowell, Mass.	523 Fletcher Street
Wells, Henry Alfred, Jr., IV, Elizabeth, N. J.	37 Varney Street
Wilkie, Robert Campbell, VI, Newton Centre, Mass.	Omicron Pi House
Young, Edmund Joseph, Jr., IV, Lowell, Mass.	545 School Street

Class of 1934

Allen, Grover Stanley, IV, Haverhill, Mass.	———
Beigbeder, Edgar Raymond, IV, Roslindale, Mass.	Omicron Pi House
Birenbaum, William, IV, Haverhill, Mass.	37 Butterfield Street
Bradford, Edward Hosmer, VI, Andover, Mass.	———
Brosnan, James Henry, IV, Lowell, Mass.	100 White Street
Bukala, Mitchell John, IV, Lowell, Mass.	3 Osgood Avenue
Burke, James Edward, IV, Lowell, Mass.	77 Durant Street
Cowan, Raymond Bernard, IV, Haverhill, Mass.	37 Butterfield Street
Crane, Eugene Francis, VI, Lowell, Mass.	517 Westford Street
Diehl, Fred Anton, VI, East Paterson, N. J.	Phi Psi House
Dunlap, Parker, VI, Lowell, Mass.	58 Hanks Street
Dunn, Austin Pember, VI, Shirley, Mass.	———
Fenn, Harris Benjamin, Jr., IV, Ridgewood, N. J.	Omicron Pi House
Fox, David James, VI, Lowell, Mass.	359 Beacon Street
Garner, John William, IV, Kezar Falls, Me.	Omicron Pi House
Genest, Roland Napoleon, IV, Lowell, Mass.	75 Westford Street
Gillespie, Francis Clifford, IV, North Andover, Mass.	———
Graham, Robert Theodore, IV, North Andover, Mass.	———
Gregory, Robert Crockett, VI, Rockland, Me.	63 Varnum Avenue
Henderson, Robert James, IV, Swampscott, Mass.	Omicron Pi House
Hevey, John Bernard, VI, Lowell, Mass.	66 Porter Terrace
Kidder, Glen Mortimer, IV, Ayer, Mass.	———
Lauder, Robert William, VI, Haverhill, Mass.	———
Lawson, Russell Munroe, VI, Andover, Mass.	———
Leblanc, Gerald Alderic, VI, Lowell, Mass.	86 White Street
Leslie, Kenneth Everett, IV, Haverhill, Mass.	———
Mamber, Solomon, VI, Brooklyn, N. Y.	37 Butterfield Street
Moody, Leon Eugene, IV, Lowell, Mass.	113 Ludlam Street
Morrison, Roland Charles, IV, Dracut, Mass.	———
Phelan, Leonard John, IV, Ipswich, Mass.	137 Riverside Street
Smith, Harold, IV, Lowell, Mass.	24 Belmont Street
Smith, William Arthur, Jr., VI, Gloucester, Mass.	Phi Psi House
Stevens, William Edwin, VI, West Warwick, R. I.	Phi Psi House
Sullivan, Joseph Michael, IV, Lowell, Mass.	28 Dunfey Street
Thomas, Benjamin, Jr., VI, Nashua, N. H.	———
Thomas, Robert Joseph, IV, Lowell, Mass.	24 Loring Street
Wynn, William Joseph, Jr., IV, Lowell, Mass.	4 Ames Place

Class of 1935

Abrahamian, Aram, IV, Watertown, Mass.	———
Alcott, Albert Stephen, Jr., IV, Lowell, Mass.	59 Canton Street
Beattie, John Silas, IV, Lowell, Mass.	17 Osgood Street
Bliss, Dorothy Myrtle, IV, Chelmsford, Mass.	———
Bogdan, John Francis, VI, Nashua, N. H.	———
Bridges, Herbert Gardner, VI, South Weymouth, Mass.	137 Riverside Street
Burke, Joseph Thomas, VI, Lowell, Mass.	109 Tyler Park
Cobb, Joseph Calvin, VI, Lowell, Mass.	5 Dover Street
Cogswell, Frederick William, IV, Maynard, Mass.	———
Connolly, Daniel Francis, Jr., IV, Salem, Mass.	12 Third Avenue
Curtin, William John, IV, Lowell, Mass.	49 Second Street
Dale, John Harold, Jr., IV, Billerica, Mass.	———
deGruchy, James Campbell, Jr., IV, Stoneham, Mass.	———
Dion, Ernest Lorenzo, IV, Lawrence, Mass.	———
Echavarria, Luis, VI, Medellin, Colombia	100 Riverside Street
Eismann, Edmund, IV, Pawtucket, R. I.	———
Fairbanks, Evan Hobbs, VI, Wakefield, Mass.	———
Farland, Ralph Carl, VI, Nashua, N. H.	157 Nesmith Street
Flood, Richard Russell, VI, Lowell, Mass.	118 Bartlett Street
Freeman, Arthur Samuel, VI, Chelsea, Mass.	32 Mount Washington St.
Gagnon, Roland Joseph, IV, Lowell, Mass.	279 Liberty Street
Garbutt, William Alton, VI, Worcester, Mass.	43 Plymouth Street
Greenbaum, Hyman Herbert, IV, Haverhill, Mass.	———
Griffin, Vernon Harcourt, IV, Swampscott, Mass.	———
Grossman, Edward, VI, Providence, R. I.	125 Mt. Washington Street
Harris, Frederick Harry, IV, Lowell, Mass.	66 Princeton Street
Harwood, Ralph, IV, Bronx, N. Y.	59 Hastings Street
Heffernan, John Vincent, IV, North Smithfield, R. I.	43 Plymouth Street
Holden, Arthur Newton, VI, North Blllerica, Mass.	———
Jarek, Walter Julius, IV, Lowell, Mass.	74 Eleventh Street
Jurewicz, Brones Joseph, IV, Lowell, Mass.	448 Lawrence Street
Kennedy, Robert Miller, VI, Dunstable, Mass.	———
Kopatch, Chester Marion, IV, Lawrence, Mass.	———
Moreno, Emilio Gomez, Jr., VI, Tucson, Ariz.	———
Oliver, Thomas William, Jr., VI, Lowell, Mass.	62 Glenwood Street
Papaconstantinou, Fotoula Argyres, IV, Lowell, Mass.	798 Rogers Street
Parechanian, James Humphrey, IV, Lowell, Mass.	1 Summer Court
Perreault, George Noah, VI, Lowell, Mass.	107 Farmland Road
Plovnick, Max David, IV, Roxbury, Mass.	———
Poremba, Leo Louis, IV, Lowell, Mass.	4 Oak Street
Schaller, Joseph Gregory, IV, Wellesley, Mass.	11 White Street
Schaltenbrand, Alfred Leo, IV, Framingham, Mass.	37 Varney Street
Schoelzel, Herman Walter, IV, Methuen, Mass.	———
Shain, Joseph, IV, Roxbury, Mass.	———
Smith, Howard Wiley, IV, Derry, N. H.	———
Stein, William Joseph, VI, East Haven, Conn.	32 Mt. Washington Street
Stolzberg, Howard Nathaniel, IV, Haverhill, Mass.	———
Storey, Edwin Gerald, VI, Chatham, N. J.	137 Riverside Street
Sullivan, Joseph Augustus, VI, Lowell, Mass.	28 Grove Street
Thayer, Oliver Alden, VI, Topsfield, Mass.	———
Thompson, George Robert, IV, Lowell, Mass.	39 Roper Street
Thompson, Henry Albert, IV, North Tewksbury, Mass.	———

Diploma Students

Class of 1932

Atkinson, Alan Alexander, II, Lowell, Mass.	77 Wilder Street
Daley, Raymond Joseph, II, Lowell, Mass.	239 Stevens Street
Golec, Edward Lucian, III, Lowell, Mass.	117 Coburn Street
Williams, Albert William, III, Lowell, Mass.	178 First Street
Yung, E–Zung, I, Shanghai, China	53 Mount Hope Street

Class of 1933

Brown, William Alden, II, Norway, Me.	Phi Psi House
Cohen, Donald Berlove, II, Rochester, N. Y.	37 Varney Street
Howard, Arthur Vincent, III, Lowell, Mass.	12 Third Ave.
Morse, Judson Pickering, II, Danvers, Mass.	Phi Psi House
Penney, Cabot William, III, Methuen, Mass.	———

Class of 1934

Baranowski, John, III, Lowell, Mass.	4 Joiner's Court
Doyle, Kenneth Barr, III, Stafford, Conn.	43 Plymouth Street

Special Students

Blomberg, Gunnar, III, Milton, Mass.	———
Cadgene, Jacques Paul, IV, Englewood, N. J.	123 Riverside Street
Crawford, John Thomas, II, Rockland, Mass.	Phi Psi House
Donahue, Edward Emerson, II, Norwood, Mass.	Phi Psi House
Dupuis, Lucien Romeo, III, Lewiston, Maine	358 Moody Street
Einstein, I. David, III, New York, N. Y.	———
Greenberg, Benjamin, III, Waltham, Mass.	———
Gustafson, Bertel William, IV, Burlington, Vt.	43 Plymouth Street
Huyck, William Francis, II, Albany, N. Y.	157 Nesmith Street
MacKenzie, Donald Charlton, VI, Lowell, Mass.	292 Wilder Street
Ray, George Robert, I, New York, N. Y.	445 Merrimack Street
Stursberg, Laird, II, New York, N. Y.	18 Astor Street
Taplin, Richard Elwell, VI, Methuen, Mass.	———

ALPHABETICAL LIST OF GRADUATES

The following list has been corrected in accordance with information received previous to February 1, 1932. Any information regarding incorrect or missing addresses is earnestly solicited.

B.T.C. indicates the degree of Bachelor of Textile Chemistry; B.T.D. indicates the degree of Bachelor of Textile Dyeing; B.T.E. indicates the degree of Bachelor of Textile Engineering; D indicates a diploma; C indicates a certificate (covering a partial course only). Degrees were issued beginning with the year 1913.

Abbot, Edward Moseley, II, '04 (D). Manufacturer, Abbot Worsted Company, Graniteville, Mass.

Abbott, George Richard, II, '08 (D). Andover, Mass.

Adams, Floyd Willington, VI, '16 (B.T.E.).

Adams, Henry Shaw, I, '05 (D). Purchasing Agent and Assistant Treasurer, Lancaster Cotton Mills, Chester, S. C.

Adams, Tracy Addison, IV, '11 (D). General Manager, Arnold Print Works, North Adams, Mass.

Albrecht, Charles Henry, IV, '17 (B.T.C.). Chemist, The Bell Company, Worcester, Mass.

Allard, Edward Joseph, IV, '31 (B.T.C.). Chemist, National Aniline & Chemical Company, Boston, Mass.

Almquist, George John Edwin, I, '19 (D). Second Vice-President, Passaic-Bergen Lumber Company, Passaic, N. J.

Anderson, Arthur Illman, IV, '24 (B.T.C.). Associate, Department of Research, Laundry-owners National Association, Joliet, Ill.

Anderson, Arthur Julius, IV, '19 (B.T.C.). Salesman, National Aniline and Chemical Company, 40 Rector Street, New York City.

Anderson, Clarence Alfred, VI, '25 (B.T.E.). Cost Department, Hoosac Mills, Butler Division, New Bedford, Mass.

Anderson, Harold Robert, II, '26 (D). Research Department, Abbot Worsted Company, Forge Village, Mass.

Annan, David, II, '23 (D). 105 Almont Street, Winthrop, Mass.

Arienti, Peter Joseph, IV, '10 (D). Chief Chemist and Dyer, Sayles Finishing Plants, Inc., Saylesville, R. I.

Arundale, Henry Barnes, II, '07 (D). In charge of Research Department, United States Testing Company, Inc., 1415 Park Avenue, Hoboken, N. J.

Atwood, Henry Jones, II, '23 (D). Assistant Superintendent, Daniels Manufacturing Company, East Brookfield, Mass.

Babb, Charles Wilkes, Jr., II, '31 (D). With Knox Woolen Company, Camden, Maine.

Babigan, Raymond, IV, '24 (B.T.C.). Associate Examiner, United States Patent Office, Washington, D. C.

Bachelder, Charles Edward, IV, '24 (B.T.C.). Supervisor in Rayon Division, Tennessee Eastman Corporation, Kingsport, Tenn.

Bailey, Joseph W., I, '99 (D). Agent, Booth Manufacturing Company, New Bedford, Mass.

Bailey, Lester Harold, IV, '24 (B.T.C.). Chemist, Slater Company, Inc., Webster, Mass.

Bailey, Walter James, IV, '11 (D). Bailey's Cleansers and Dyers, Watertown, Mass.

Baker, Franz Evron, VI, '26 (B.T.E.). Instructor, Cotton Yarn Department, Lowell Textile Institute, Lowell, Mass.

Baker, Maurice Sidney, IV, '25 (B.T.C.). Merchant, Fine's, Attleboro, Mass.

Baker, William John, IV, '16 (D). Supervisor, Du Pont Rayon Company, Old Hickory, Tenn.

Baker, William Samuel, I, '26 (D). Assistant Systemizer, Nashua Manufacturing Company, Nashua, N. H.

Balch, Ralph Herman, VI, '29 (B.T.E.). Celanese Corporation of America, Amcelle, Md.

Baldwin, Frederick Albert, II, '04 (D). Vice-President and Secretary, Walter Blue & Co., Ltd., Sherbrooke, Que.

Barlofsky, Archie, VI, '17 (B.T.E.). Merchant, Economy Cash Market, 165 Chelmsford Street, Lowell, Mass.

Barr, I. Walwin, I, '00 (D). Second Vice-President, Buckley Brothers Company, 881 Broadway, New York City.

Barrett, Andrew Edward, IV, '23 (B.T.C.). Field Engineer, Armour & Co. (Industrial Soap Division), North Bergen, N. J.

Barry, Leo Joseph, II, '27 (D). With the Bell Company, Worcester, Mass.

Bard, Morry Arnold, IV, '30 (B.T.C.). Chemist and Assistant Dyer, Pohatcong Hosiery Mills, Inc., Washington, N. J.

Bauer, Harold Conrad, III, '28 (D). Assistant Designer, Merrimac Mills, Methuen, Mass.

Beck, Frederic Christian, II, '24 (D). In business, Weld & Beck, Southbridge, Mass.

Beeman, Earl, VI, '30 (B.T.E.). Research Department, Pacific Mills, Lawrence, Mass.

Bell, Edward Benjamin, IV, '24 (B. T. C.). With Wallerstein Textiles, 270 Fourth Avenue, New York City.

Bennett, E. Howard, II, '03 (C). Publisher, Frank P. Bennett & Co., 530 Atlantic Avenue, Boston, Mass.

Bentley, Byron, II, '26 (D). With Joseph Bentley Hair Company, Methuen, Mass.

Bergeron, Alvin Wilfred, IV, '29 (B.T.C.). Textile Chemist, Celanese Corporation of America, Amcelle, Md.

Berry, Wilbur French, II, '17 (D).

Bienstock, George Jerrard, III, '24 (D). Research Director and Woolen Stylist, The Bloch Company, Cleveland, Ohio.

Billings, Borden Dickinson, I, '29 (D). Superintendent, Thorndike Company, West Warren, Mass.

Bird, Clarence Henry, II, '22 (D). Superintendent, George E. Duffy Manufacturing Co., Worcester, Mass.

Bird, Francis John, VI, '22 (B.T.E.). 30 West Street, Attleboro, Mass.

Blaikie, Howard Mills, II, '11 (D). 17 Maywood Avenue, Maywood, N. J.

Blake, Parker Gould, VI, '14 (D). District Manager, Claude Denis & Co., Ltd., Toronto, Ont.

Blanchard, John Lawrence, II, '23 (D). Designer, Farnsworth Company, Lisbon Centre, Me.

Bodwell, Henry Albert, II, '00 (D). With Ludlow Manufacturing Associates, 80 Federal Street, Boston, Mass.

Booth, James Mooney, IV, '24 (B.T.C.). Salesman, The Huron Milling Company, Inc., 9 Park Place, New York City.

Bottomley, John, III, '28 (D). Assistant Designer, Amoskeag Manufacturing Company, Manchester, N. H.

Boyd, George Andrew, I, '05 (D). West Boylston, Mass.

Brackett, Martin Richard, II, '22 (D). Member of firm, J. K. Taylor & Co., 450 7th Avenue, New York City.

Bradford, Harold Palmer, II, '25 (D). 90 Beach Street, Malden, Mass.

Bradford, Roy Hosmer, II, '06 (D). Textile Machinery, 161 Devonshire Street, Boston, Mass.

Bradford, William Swanton, VI, '31 (B.T.E.). Woolen Division, Lawrence Manufacturing Company, Lowell, Mass.

Bradley, Raymond Frost, VI, '14 (D). Garage Proprietor, Twin Light Garage, 267 East Main Street, Gloucester, Mass.

Bradley, Richard Henry, V, '01 (C). Gasoline Salesman, Fairhaven, Mass.

Brainerd, Arthur Travena, IV, '09 (D). Manager, Ciba Company, 325 West Huron Street, Chicago, Ill.

Brainerd, Carl Emil, IV, '20 (B.T.C.). Overseer of Dyeing, F. C. Huyck & Sons, Albany, N. Y.

Brandt, Carl Dewey, VI, '20 (B.T.E.). Head of Textile Engineering Department, Texas Technological College, Lubbock, Texas.

Brannen, Leon Vincent, III, '07 (C).

Brickett, Chauncy Jackson, II, '00 (D). Director, School of Textile Manufacturing and Designing, International Correspondence School, Scranton, Pa.

Brickett, Raymond Calvin, II, '14 (D). Overseer, M. T. Stevens & Sons Company (Marland Mills), Andover, Mass.

Brigham, Howard Mason, VI, '24 (B.T.E.). Salesman, Wellington, Sears & Co., 65 Worth Street, New York City.

Bronson, Howard Seymour, II, '27 (D). Overseer of Knitting, Portage Hosiery Company, Portage, Wis.

Brosnan, William Francis, IV, '27 (B.T.C.). Vice-President and General Manager, Antipyros Company, 338 Berry Street, Brooklyn, N. Y.

Brown, Gerald Marston, VI, '22 (B.T.E.). Employment Manager, Willimantic Silk Company, Willimantic, Conn.

Brown, Philip Franklin, II, '23 (D). District Sales Manager, DuPont Rayon Company, 350 Fifth Avenue, New York City.

Brown, Rollins Goldthwaite, IV, '12 (D). Sales Representative, White Brothers, Inc., Winchendon Springs, Mass.

Brown, Russell Lee, VI, '21 (B.T.E.). Assistant Professor, Lowell Textile Institute, Lowell, Mass.

Brown, Will George, Jr., IV, '22 (B.T.C.). Chemist, American Hide & Leather Company, Lowell, Mass.

Buchan, Donald Cameron, II, '01, (D). Assistant Superintendent, M. T. Stevens & Sons Company, North Andover, Mass.

Buchan, Norman Spaulding, IV, '26 (B.T.C.). Overseer of Dyeing, Pitman Manufacturing Company, Laconia, N. H.

Burbeck, Dorothy Maria, IV, '20 (B.T.C.). See Garlick, Mrs. Dorothy M.

Burger, Samuel Joseph, III, '24 (D). President, Heat Maintenance Service, Inc., Brooklyn, N. Y.

Burnham, Frank Erwin, IV, '02 (D). Dyestuff Chemist, Pacific Mills, Worsted Division, Lawrence, Mass.

Burns, Robert, IV, '28 (B.T.C.). Chemist, Celanese Corporation of America, Amcelle, Md.

Burtt, Joseph Frederic, VI, '31 (B.T.E.). Lowell Silk Mills, Lowell, Mass.

Buzzell, Harry Saville, VI, '29 (B.T.E.). Foreman of Raw Materials Laboratory, Oxford Paper Company, Rumford, Maine.

Callahan, John Joseph, Jr., II, '26 (D). Color Chemist, A. Klipstein & Co., 263 Summer Street, Boston, Mass.

Cameron, Elliott Francis, IV, 'II (D). Attorney-at-law, Willard, Allen and Mulhern, 100 Milk Street, Boston, Mass.

Campbell, Alexander, VI, '23 (B.T.E.). Mechanical Engineer, Charles T. Main, Inc., Engineers, 201 Devonshire Street, Boston, Mass.

Campbell, Louise Porter, IIIb, '03 (C). With Ginn & Co., 15 Ashburton Place, Boston, Mass.

Campbell, Orison Sargent, II, '03 (D). Superintendent of Felt Department, Consolidated Felts, Ltd., Kitchener, Ont.

Cannell, Philip Stuart, VI, '23 (B.T.E.). Industrial Engineer, J. & P. Coats, Inc., Pawtucket, R. I.

Carbone, Alfred John, IV, '31 (B.T.C.). Textile Chemist, American Woolen Company, Andover, Mass.

Carleton, Joseph Raddin, III, '30 (D). Park Avenue, Bradford, Mass.

Carr, George Everett, I, '05 (D). Industrial Engineer, C. F. Mueller Company, 180 Baldwin Avenue, Jersey City, N. J.

Carr, Paul Edward, II, '24 (D) Designer, Pondicherry Woolen Company, Bridgton, Me.

Carter, Robert Albion, IV, '02 (D). District Salesman, E. I. du Pont de Nemours & Co., 128 South Front Street, Philadelphia, Pa.

Carter, Russell Albert, II, '25 (D). With Thermo Mills, Inc., West Sand Lake, N. Y.

Cary, Julian Clinton, VI, '10 (D). Branch Manager, The American Mutual Liability Insurance Company, 226 Pearl Street, Hartford, Conn.

Casey, Francis Harold, IV, '31 (B.T.C.). General Cleansers and Dyers, Inc., Holyoke, Mass.

Caya, Ferdinand Joseph, IV, '22 (B.T.C.). P.O. Box 515, Dover, N. J.

Chamberlin, Frederick Ellery, I, '03 (D). Overseer of Spinning, Monument Mills, Housatonic, Mass.

Chandler, Proctor, IV, '11 (D). Manager, Chandler Manufacturing Company, 56 Amherst Street, Cambridge, Mass.

Chang, Chi, VI, '23 (B.T.E.).

Chang, Wen Chuan, VI, '21 (B.T.E.). Dah Sung Cotton Mill No. 1, Nantung, Kiangsu, China.

Chapman, Leland Hildreth, VI, '24 (B.T.E.). Vice-Principal, Hingham High School, Hingham, Mass.

Chen, Shih Ching, IV, '22 (B.T.C.). Hou Sung Cotton Mill, Shanghai, China.

Chen, Wen-Pei, IV, '24 (B.T.C.).

Chisholm, Lester Bury, I, '11 (D). General Plant Manager, American Mills Company, Waterbury, Conn.

Church, Charles Royal, II, '06 (C).

Churchill, Charles Whittier, III, '06 (D). Manager, Churchill Manufacturing Company, Inc., Lowell, Mass.

Clapp, F. Austin, II, '04 (D). Insurance Broker, White Plains, N. Y.

Clark, Earl William, IV, '18 (B.T.C.). 32 Strong Street, Manchester, Conn.

Clark, Thomas Talbot, II, '10 (D). President and Treasurer, Talbot Mills, North Billerica, Mass.

Clarke, George Dean, II, '21 (C). Dyer, Seamans & Cobb Thread Mills, Hopkinton, Mass.

Clayton, Harold Edmund, VI, '21 (B.T.E.). Manager, Brown Hosiery Company, Lowell, Mass.

Cleary, Charles Joseph, II, '13 (D). Textile Technologist, United States Army Air Service, Wright Field, Dayton, Ohio.

Clement, David Scott, IV, '24 (B.T.C.). Chemist, Nashua Manufacturing Company, Nashua, N. H.

Cleveland, Richard Sumner, VI, '30 (B.T.E.). Junior Textile Technologist, National Bureau of Standards, Department of Commerce, Washington, D. C.

Clifford, Albert Chester, VI, '22 (B.T.E.). Textile Engineer, Western Electric Company, Inc., Kearny, N. J.

Clogston, Raymond B., IV, '04 (D). Superintendent of Dyeing, Merrimack Manufacturing Company, Lowell, Mass.

Cluett, John Girvin, I, '29 (D). Textile Analyst and Assistant to Superintendent at Bleachery, Cluett, Peabody & Co., Inc., Peebles Island, Waterford, N. Y.

Coan, Charles Bisbee, IV, '12 (D.)

Coffey, Daniel Joseph, III, '28 (D). 128 Brown Street, Pittsfield, Mass.

Cohen, Arthur Edward, IV, '23 (B.T.C.)

Cohen, Raphael Edvab, IV, '25 (B.T.C.) Secretary and Sales Manager, Merrimack Paper Tube Company, Inc., Lowell, Mass.

Colby, J. Tracy, VI, '16 (D). Salesman, F. C. Huyck & Sons, Empire State Building, Room 1502, New York City.

Colby, Willard Alvah, Jr., IV, '30 (B.T.C.). Assistant Dyer, Utica Willowvale Bleaching Company, Chadwicks, N. Y.

Cole, Edward Earle, IV, '06 (D). Financial Agent, The Bradstreet Company, Boston, Mass.

Cole, James Thomas, II, '05 (D). Treasurer, Arlington Industries for the Blind, Arlington, Mass.

Collonan, Herbert Joseph, II, '22 (D). Moosup, Conn.

Coman, James Groesbeck, I, '07 (D). Superintendent, Mexia Textile Mills, Mexia, Texas.

Conant, Harold Wright, I, '09 (D). Assistant Treasurer, United Elastic Corporation, Easthampton, Mass.

Conant, Richard Goldsmith, I, '12 (D). Sales Executive, Wellington, Sears & Co., 65 Worth Street, New York City.

Conklin, Jennie Grace, IIIb, '05 (C). See Nostrand, Mrs. William L.

Connor, Thomas Francis, II, '28 (D). 41 Elmore Street, Roxbury, Mass.

Connorton, John Joseph, Jr., III, '27 (D). Head Designer, Amoskeag Manufacturing Company, Manchester, N. H.

Cook, Kenneth Bartlett, I, '13 (D). Technical Manager, Manville-Jenckes Company, Pawtucket, R. I.

Corbett, James Francis, IV, '28 (B.T.C.). Chemist, Pacific Mills Print Works, Lawrence, Mass.

Cote, Theodore Charles, IV, '26 (B.T.C.). Chemist, Merrimack Manufacturing Company, Lowell, Mass.

Craig, Albert Wood, IV, '07 (D). Superintendent, Windsor Print Works, North Adams, Mass.

Craig, Clarence Eugene, III, '02 (D).

Creese, Guy Talbot, IV, '14 (D). Chemist, Creese & Cook Company, Danversport, Mass.

Crowe, Joseph Bailey, IV, '25 (B.T.C.). Chemical Engineer, Textile Research Department, Procter & Gamble Co., Ivorydale, Ohio.

Culver, Ralph Farnsworth, IV, '04 (D). Vice-President and Manager, Providence Office, Ciba Company, Inc., 61 Peck Street, Providence, R. I.

Cummings, Edward Stanton, VI, '16 (D). Industrial Engineer, with Ralph E. Loper & Co., Greenville, S. C.

Curran, Charles Ernest, III, '02 (C). Head Designer, Wood Worsted Mills, Lawrence, Mass.

Currier, Herbert Augustus, I, '06 (D). Waterman, Currier & Co., Inc., Cotton Yarn Merchants, 40 Worth Street, New York City.

Currier, John Alva, II, '01 (D). Superintendent, Pentucket Mills (M. T. Stevens & Sons Company), Haverhill, Mass.

Curtis, Frank Mitchell, I, '06 (D). Retail Lumber, Wm. Curtis Sons Company, 10 Blue Hill Avenue, Milton, Mass.

Curtis, William Leavitt, II, '05 (C.)

Cutler, Benjamin Winthrop, Jr., III, '04 (D). Department Manager, Worth Textile Company, 40 Worth Street, New York City.

Cuttle, James H., II, '99 (D). Superintendent, S. Stroock & Co., Inc., Newburgh, N. Y.

Dalton, Gregory Smith, IV, '12 (D).

Danahy, Arthur Joseph, IV, '31 (B.T.C.). 37 Clark Street, Lowell, Mass.

Darby, Avard Nelson, II, '28 (D). General Foreman, Plant No. 2, Merrimac Hat Corporation, Amesbury, Mass.

Datar, Anant Vithal, VI, '24 (B.T.E.). Secretary and Manager, The Pulgaon Cotton Manufacturing Company, Ltd., Pulgaon, C. P., India.

Davidson, Sydney, III, '28 (D). 64 Devon Street, Roxbury, Mass.

Davieau, Alfred Edward, VI, '16 (D). Textile Engineer, United States Testing Company, Inc., 316 Hudson Street, New York City.

Davieau, Arthur Napoleon, VI, '13 (D). Superintendent, Kenwood Mills, Ltd., (F. C. Huyck & Sons), Arnprior, Ont.

Davieau, Leon Arthur, VI, '23 (B.T.E.). With United States Rubber Company (Textile Section), Market and South Streets, Passaic, N. J.

Davis, Alexander Duncan, VI, '14 (B.T.E.). Instructor, Northeastern University, Springfield, Mass.

Dearborn, Roy S., VI, '13 (D). Salesman, Dumas & Co., Lowell, Mass.

Dearth, Elmer Elbridge, IV, '12 (D). General Plant Manager, The Fisk Rubber Company, Chicopee Falls, Mass.

Del Plaine, Parker Haywood, IV, '25 (B.T.C.). Southern Manager, Rohn & Haas Company, 1109 Independent Building, Charlotte, N. C.
Derby, Roland Everett, IV, '22 (B.T.C.). Chemist, M. T. Stevens & Sons Company, North Andover, Mass.
de Sa, Francisco, VI, '18 (B.T.E.). Avenue da Graca, Bahia, Brazil.
Dewey, James French, II, '04 (D). Woolen Manufacturer, A. G. Dewey Company, Quechee, Vt.
Dewey, Maurice William, II, '11 (D). With National Life Insurance Company, Montpelier, Vt.
Dillon, James Henry, III, '05 (D).
Dods, James Barber, II, '27 (D). Vice-President and General Manager, The Dods Knitting Company, Ltd., Orangeville, Ont.
Dolan, William Francis, IV, '28 (B.T.C.). Dyer, Lowell Bleachery South, Griffin, Ga.
Donald, Albert Edward, II, '04 (D). Agent, H. T. Hayward Company, Franklin, Mass.
Donovan, Joseph Richard, IV, '24 (B.T.C.). Proprietor, Scientific Laundry, 484 Main Street, Charlestown, Mass.
Doran, Wilbur Kirkland, II, '22 (D).
Dorr, Clinton Lamont, VI, '14 (D). Merchant, Raymond's, Inc., 356 Washington Street, Boston, Mass.
Douglas, Walter Shelton, II, '21 (D). Estimator, Douglas & Co., Lowell, Mass.
Duggan, Paul Curran, IV, '31 (B.T.C.). Assistant Chemist, Gotham Silk Hosiery Company, 580 First Avenue, New York City.
Duguid, Harry Wyatt, I, '24 (D). Assistant Superintendent, Maverick Mills, East Boston, Mass.
Dunlap, Kirke Harold, Jr., VI, '30 (B.T.E.). Textile Engineer, Kenwood Mills, Ltd., Arnprior, Ont.
Dunnican, Edward Tunis, VI, '24 (B.T.E.). With Pacific Mills, 40 Worth Street, New York City.
Durgin, William Ernest, IV, '24 (B.T.C.). Textile Chemist, Geigy Company, Inc., 88 Broad Street, Boston, Mass.
Duval, Joseph Edward, II, '10 (D). Yarn Agent, 308 Chestnut Street, Philadelphia, Pa.
Dwight, John Francis, Jr., II, '08 (D). Hazel Avenue, Scituate, Mass.

Echmalian, John Gregory, VI, '16 (B.T.E.). Director, State Trade School, South Manchester, Conn.
Ehrenfried, Jacob Benjamin, II, '07 (C). Manager, George Ehrenfried Company, Lewiston, Maine.
Elliott, Gordon Baylies, II, '12 (D). Planning Department, Pacific Mills, Lawrence, Mass.
Ellis, Charles Albert, VI, '21 (B.T.E.). Engineer, City of Syracuse, Syracuse, N. Y.
Ellis, Dorothy Myrta, VI, '25 (B.T.E.). Junior Cotton Technologist, Department of Agriculture, Washington, D. C.
Ellis, James Oliver, VI, '29 (B.T.E.). Designing, Sidney Blumenthal & Co., Inc., Shelton, Conn.
Emerson, Frank Warren, II, '03 (D). 130 Butman Road, Lowell, Mass.
Engstrom, Karl Emil, VI, '12 (D). **(S.B. 1916, Massachusetts Institute of Technology.)** 36 Fairfield Street, Boston, Mass.
Enloe, Winfred Paige, I, '22 (D). Assistant Superintendent, The W. A. Handley Manufacturing Company, Roanoke, Ala.
Evans, Alfred Whitney, III, '03 (D).
Evans, Paul Richard, II, '29 (D). With United States Testing Company, New York City.
Evans, William Robinson, III, '03 (D). 309 Main Street, Bradford, Mass.
Everett, Charles Arthur, IV, '19 (B.T.C.). Instructor, Dyeing Department, Lowell Textile Institute, Lowell, Mass.
Ewer, Nathaniel Trull, IV, '01 (D).

Fairbanks, Almonte Harrison, II, '09 (D). Treasurer and Manager, Middlesex Knitting Company, Wakefield, Mass.
Farley, Clifford Albert, VI, '28 (B.T.E.). Office Manager, Thorndike Company, West Warren, Mass.
Farmer, Chester Jefferson, IV, '07 (D). (Ph.D. Harvard University.) Professor of Chemistry, Northwestern University Medical School, Chicago, Ill.
Farnsworth, Harold Vincent, VI, '16 (B.T.E.). Textile Engineer, Atkinson, Haserick & Co., 152 Congress Street, Boston, Mass.
Farr, Leonard Schaefar, II, '08 (D). Assistant Superintendent, No. 2 Mill, Farr Alpaca Company, Holyoke, Mass.
Farwell, Claude Chapman, VI, '23 (B.T.E.). Groton, Mass.
Fasig, Paul Leon, IV, '28 (B.T.C.). Industrial Fellow, Mellon Institute of Industrial Research, Pittsburgh, Pa.
Feinberg, Benjamin, II, '27 (D). General Manager, Bradford Hat Company, Haverhill, Mass.
Feindel, George Paul, IV, '24 (B.T.C.). Chemist, Union Bleachery, Greenville, S. C.
Feldstein, Martin Alexander, VI, '24 (B.T.E.) Radio Engineer, General Electric Company, Hotel Majestic, Lakewood, N. J.
Fels, August Benedict, II ,'99 (D). 190 Carroll Street, Paterson, N. J.
Ferguson, Arthur Feiling, I, '03 (D).
Ferguson, William Gladstone, III, '09 (D). Assistant Agent, Ludlow Manufacturing Associates, Ludlow, Mass.
Ferris, Arthur Leon, II, '28 (D). Port Rowan, Ont.
Finlay, Harry Francis, IV, '10 (D). Chemist and Demonstrator, National Aniline and Chemical Company, Boston, Mass.
Fisher, Russell Todd, VI, '14 (D). '25 (B.T.E.). Secretary, National Association of Cotton Manufacturers, 80 Federal Street, Boston, Mass.
Fiske, Starr Hollinger, II, '09 (D). Owner and Manager, Wing's Cash Market, Lowell, Mass.
Fitzgerald, John Francis, IV, '18 (B.T.C.). Dyer, Golden Bell Cleaners, Inc., Malden, Mass.
Fitzgerald, John Francis, IV, '28 (B.T.C.). Textile Chemist, Pawtucket Testing Laboratories, Pawtucket, R. I.
Fleischmann, Meyer, IV, '20 (B.T.C.). Chief Chemist, Real Silk Hosiery Mills, Indianapolis, Ind.
Fleming, Frank Everett, IV, '06 (D). Superintendent, Dyeing and Finishing, Goodall Worsted Company, Sanford, Maine.
Fletcher, Howard Varnum, III, '25 (D). Salesman, Sun Oil Company, Poughkeepsie, N. Y.
Fletcher, Roland Hartwell, VI, '10 (D). With Pressed Steel Car Company, Pittsburgh, Pa.
Flood, Thomas Henry, IV, '27 (B.T.C.). Sales Department, National Aniline & Chemical Company, 40 Rector Street, New York City.
Flynn, Thomas Patrick, IV, '11 (D). Sales Manager, E. L. Thompson Chair Corporation, Baldwinsville, Mass.
Ford, Edgar Robinson, IV, '11 (D). Technical Superintendent, Sayles Biltmore Bleacheries, Biltmore, N. C.
Ford, Stephen Kenneth, IV, '28 (B.T.C.). Chemist, Martin-Wild, 500 Columbia Street, Somerville, Mass.
Forsaith, Charles Henry, VI, '20 (B.T.E.). Superintendent, Nashua Manufacturing Company (Jackson Mills), Nashua, N. H.
Forsaith, Ralph Allen, VI, '16 (B.T.E.). With Anderson-Meyer Company, Ltd., Shanghai, China.
Forsyth, Harold Downes, VI, '23 (B.T.E.). Treasurer, Wm. Forsyth & Sons Company, Lynn, Mass.
Foster, Boutwell Hyde, VI, '17 (B.T.E.). Manager, Textile Section, United States Rubber Company, 451 South Jefferson Street, Orange, N. J.
Foster, Clifford Eastman, II, '01 (D). 35 Mount Vernon Street, New Bedford, Mass.

Fowle, Edwin Daniels, VI, '24 (B.T.E.). Associate Editor, "Textile World," 330 West 42nd Street, New York City.

Franks, Jerome, VI, '27 (B.T.E.). (**M.S. 1929, Massachusetts Institute of Technology.**) 44 Midwood Street, Brooklyn, N. Y.

Fredrickson, Charles Joseph, Jr., IV, '29 (B.T.C.). Technical Research, National Leather Company, Peabody, Mass.

French, Wallace Howe, IV, '31 (B.T.C.). Chemist, Lawrence Manufacturing Company, Lowell, Mass.

Frost, Harold Benjamin, II, '12 (D). Salesman, Liberty Mutual Insurance Company, Boston, Mass.

Fuller, Allen Reed, IV, '17 (B.T.C.). Textile Chemist, A. E. Staley Manufacturing Company, Decatur, Ill.

Fuller, George, I, '03 (D). Consulting Textile Specialist, Cox and Fuller, 320 Broadway, New York City.

Gahm, George Leonhard, II, '06 (D). Worsted Yarn Superintendent, Wood Worsted Mills, Lawrence, Mass.

Gainey, Francis William, IV, '11 (D). Assistant Superintendent, Cheney Brothers, South Manchester, Conn.

Gale, Harry Laburton, III, '10 (D). Sales Manager, Colored Goods Department, Iselin-Jefferson Company, 328 Broadway, New York City.

Gallagher, Arthur Francis, IV, '30 (B.T.C.). With Hillsborough Mills, Wilton, N.H.

Gallagher, John Waters, II '27 (D). 19 Robinson Avenue, Danbury, Conn.

Garlick, Mrs. Dorothy M. (Burbeck, Dorothy M.), IV, '20 (B.T.C.). 192 Great Road, Maynard, Mass.

Garner, Allen Frank, II, '30 (D). Assistant Superintendent, Kezar Falls Woolen Company, Kezar Falls, Me.

Gaudet, Walter Urban, II, '29 (D). Mill Department, Wellington, Sears & Co., 65 Worth Street, New York City.

Gay, Olin Dow, II, '08 (D). President, Gay Brothers Company, Cavendish, Vt.

Gerrish, Walter, III, '03 (D).

Gillie, Stanley James, I, '22 (D). Assistant Manager, United States Testing Company, Inc., 207 Chestnut Street, Philadelphia, Pa.

Gillon, Sara Agnes, IIIb, '06 (C).

Gilman, Ernest Dana, II, '26 (D). Designer, Pacific Mills, Worsted Division, Lawrence, Mass.

Glickman, Bernhardt Brecher, IV, '27 (B.T.C.). (**B.S. 1931, Columbia University.**) Optometrist, 601 East 17th Street, New York City.

Godfrey, Harold Thomas, VI, '26 (B.T.E.). Field Engineer, Davis & Furber Machine Co., North Andover, Mass.

Goldberg, George VI, '10 (D). Salesman, Liberty Lace and Braid Company, 88 Bedford St., Boston, Mass.

Goldenberg, Louis G., VI, '27 (B.T.E.). Foreman of Knitting, Raynit Mills, Brooklyn, N. Y.

Goldman, Moses Hyman, IV, '20 (B.T.C.). Chemist, Moles Products Company, 364 Cambridge Street, Allston, Mass.

Goller, Harold Poehlmann, II, '23 (D).

Goodhue, Amy Helen, IIIb, '00 (C). See Harrison, Mrs. Arthur.

Gooding, Francis Earle, IV, '19 (B.T.C.). Superintendent, Calco Chemical Company, Bound Brook, N. J.

Goosetrey, Arthur, IV, '21 (B.T.C.).

Goosetrey, John Thomas, IV, '21 (B.T.C.). Assistant Dyer, New York Mills Corporation, New York Mills, N. Y.

Gottschalck, Lawrence William, VI, '28 (B.T.E.). With Scott & Williams, Inc., 366 Broadway, New York City.

Gould, Norman Culver, VI, '19 (B.T.E.). Textile Designer, F. C. Huyck & Sons, Renssalaer, N. Y.

Greenbaum, Herbert Baron, III, '29 (D). Assistant Styler, American Woolen Company, 225 Fourth Avenue, New York City.

Greenberg, Archie, II, '21 (D). Treasurer, M. H. Corash Company, Inc. Worcester, Mass.
Greendonner, George John, Jr., IV, '30 (B.T.C.). With National Aniline & Chemical Co., Inc., Buffalo, N. Y.
Greenwood, John Roger, Jr., II, '27 (D). Assistant Superintendent, D. N. Taft Manufacturing Company, Oxford, Mass.
Gross, Herman Peter, IV, '30 (B.T.C.). 94 Shanley Avenue, Newark, N. J.
Guild, Lawrence Winfield, VI, '27 (B.T.E.). Salesman, Du Pont Rayon Company, 941 Hospital Trust Building, Providence, R. I.
Gwinnell, George Harry, II, '25 (D). Designer, Berkshire Woolen Company, Pittsfield, Mass.
Gyzander, Arne Kolthoff, IV, '09 (D). With National Aniline and Chemical Co., Inc., 40 Rector Street, New York City.

Haddad, Nassib, VI, '23 (B.T.E.). Textile Engineer, United States Rubber Company, Passaic, N. J.
Hadley, Richard Francis, IV, '22 (B.T.C.). Vice-President, Carbon Coal & Coke Company, 80 Federal Street, Boston, Mass.
Hadley, Walter Eastman, IV, '08 (D). Analytical and Consulting Chemist, Maplewood, N. J.
Hadley, Wilfred Nourse, II, '22 (D). Salesman, Parks & Woolson Machine Company, Springfield, Vt.
Hager, Hazen Otis, II, '21 (C). Treasurer, Suburban Gas and Equipment Company, Portland, Maine.
Hale, Ralph Edgar, IV, '31 (B.T.C.). Textile Chemist, The Bell Company, Worcester, Mass.
Hall, Frederick Kilby, VI, '24 (B.T.E.). (A. M. 1930, The George Washington University.) Marketing Specialist, Merchandising Research Division, United States Department of Commerce, Washington, D. C.
Hall, Stanley Arundel, IV, '31 (B.T.C.). Arnold Print Works, North Adams, Mass.
Halsell, Elam Ryan, I, '04 (C). Assistant Superintendent, Whittenton Manufacturing Company, Taunton, Mass.
Hammond, Chester Twombly, II, '23 (D). Wool Department, Mohawk Carpet Mills, Inc., Amsterdam, N. Y.
Hanscom, Edwin Thomas, II, '27 (D). Designer and Technical Expert, Hartford Woolen Mills, Hartford, Vt.
Hardie, Newton Gary, I, '23 (D). Superintendent, Oconee Mills Company, Westminster, S. C.
Hardy, Philip Lewis, VI, '10 (D). Contractor, Andover, Mass.
Harmon, Charles Francis, I, '99 (D).
Harrington, Thomas, IV, '15 (D). Superintendent, Monarch Leather Company, 1127 West Division Street, Chicago, Ill.
Harris, Charles Edward, I, '05 (D). Superintendent, Martin Rocking Fifth Wheel and Trailer Company, Westfield, Mass.
Harris, George Simmons, I, '02 (C). Cotton Manufacturing, Hunter Securities Company, Atlanta, Ga.
Harrison, Mrs. Arthur (Goodhue, Amy Helen), IIIb, '00 (C). R. F. D. No. 2, Lowell, Mass.
Hart, Arthur Norman, IV, '19 (B.T.C.).
Hart, Howard Roscoe, I, '23 (D). Superintendent, Victory Manufacturing Company, Fayetteville, N. C.
Haskell, Walter Frank, IV, '02 (D). Overseer of Dyeing, Dana Warp Mills, Westbrook, Maine.
Hassett, Paul Joseph, IV, '12 (D). Production Manager, Cortland Works, L. C. Smith & Corona Typewriters, Inc., Syracuse, N. Y.
Hathaway, William Tabor, II, '26 (D). 9 Tenney Street, North Cambridge, Mass.
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Hay, Ernest Crawford, II, '11 (D). Superintendent, Monomac Spinning Company, Lawrence, Mass.

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Hennigan, Arthur Joseph, II, '06 (D). President, E. L. Bornemann, 225 Fourth Avenue, New York City.

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Hildreth, Harold William, II, '07 (D). Draftsman, C. G. Sargent's Sons Corporation, Graniteville, Mass.

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Hoffman, Richard Robert, II, '21 (C).

Holbrook, Ralph Wentworth, IV, '29 (B.T.C.). Textile Chemist and Colorist, General Dyestuff Corporation, 159 High Street, Boston, Mass.

Holden, Francis Crawford, IV, '09 (D). Chemist, Chelsea Fibre Mills, 1155 Manhattan Avenue, Brooklyn, N. Y.

Holden, John Sanford, II, '20 (D). Manufacturer, Automatic Machine Products Company, Attleboro, Mass.

Holgate, Benjamin, III, '02 (C). Agent, Boott Mills, Lowell, Mass.

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Hood, Leslie Newton, IV, '12 (D). Bleachery Superintendent, Selma Manufacturing Company, Selma, Ala.

Hook, Russell Weeks, IV, '05 (D). Textile Chemist, Arthur D. Little, Inc., 30 Charles River Road, Cambridge, Mass.

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Horsfall, George Gordon, II, '04 (C). Assistant Dyer, Interwoven Mills, Inc., Martinsburg, W. Va.

Horton, Chester Temple, VI, '14 (B.T.E.). Wilmington, Mass.

Hosmer, Frank Barbour, IV, '31 (B.T.C.). Hosmer Dye and Hosiery Company, Lowell, Mass.

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Hsu, Hsueh-Chang, VI, '23 (B.T.E.).

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Hubbard, Ralph King, IV, '11 (D). President and Treasurer, Packard Mills, Inc., Webster, Mass.

Huising, Geronimo Huerva, I, '08 (D).

Hunt, Chester Lansing, III, '05 (C).

Hunton, John Horace, II, '11 (D). Superintendent, Wool Department, Nashua Manufacturing Company, Nashua, N. H.

Hurd, Ira Swain, IV, '29 (B.T.C.). Textile Chemist, Glenlyon Print Works, Phillipsdale, R. I.

Hurtado, Leopoldo, Jr., VI, '10 (D). General Manager, Hurtado & Co., Uruapan Michoacan, Mex.

Hurwitz, Jacob, IV, '23 (B.T.C.).

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Hyman, Wolfred, II, '28 (D). With Hyman Brothers, Boston, Mass.

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Jelleme, William Oscar, I, '10 (D). With Pacific Mills, 214 Church Street, New York City.

Jen, Shang Wu, I, '21 (D).

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Johnson, Arthur Kimball, IV, '13 (D). (S.B. 1917, Massachusetts Institute of Technology.) Research Chemist, Cheney Brothers, South Manchester, Conn.

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Jones, Everett Amos, III, '05 (D). Superintendent, Nye & Wait Kilmarnock Corporation, Auburn, N. Y.

Jones, Nathaniel Erskine, I, '21 (D). Assistant Superintendent, E. L. Watkins, 604 Forest Avenue, Portland, Maine.

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Kao, Chieh-Ching, VI, '23 (B.T.E.).

Karanfilian, John Hagop, VI, '21 (B.T.E.).

Kay, Harry Pearson, II, '09 (D). Associate Member, Stanford Wright Agency, Penn Mutual Life Insurance Company, Boston, Mass.

Kendall, Charles Henry, II, '23 (D). Superintendent and Designer, Bridgewater Woolen Company, Bridgewater, Vt.

Kennedy, Francis Charles, VI, '26 (B.T.E.). Product Development Department, The Fisk Rubber Company, Chicopee Falls, Mass.

Kenney, Frederick Leo, II, '27 (D). Assistant Designer, Uxbridge Worsted Company, Uxbridge, Mass.

Kent, Clarence LeBaron, III, '06 (C). Manager, Standard Oil Company, South Portland, Maine.

Keough, Wesley Lincoln, II, '10 (D). 491 Eldora Road, Pasadena, Calif.

Killheffer, John Vincent, IV, '28 (B.T.C.). Textile Chemist, and Assistant Southern Laboratory Manager, E. I. du Pont de Nemours & Co., Inc., Charlotte, N. C.

Kilmartin, John Joseph, I, '31 (D). 62 Highland Avenue, Lowell, Mass.

Kingsbury, Percey Fox, IV, '01 (D). Print Manager, Passaic Print Works, Passaic, N. J.

Knowland, Daniel Power, IV, '07 (D). Chief Chemist, Geigy Company, Inc., 89 Barclay Street, New York City.

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Kolsky, Samuel Irving, IV, '30 (B.T.C.). Textile Chemist, Pawtucket Testing Laboratories, Pawtucket, R. I.

Konieczny, Henry, IV, '30 (B.T.C.). Supervisor of Dyeing, Brennan's, Inc., Detroit, Mich.

Kostopoulos, Emanuel Arthur, VI, '30 (B.T.E.). With New Hampshire Mills, Manchester, N. H.

Krishan, Maharaj, VI, '30 (B.T.E.). Montgomery, India.

Kuo, Limao, VI, '26 (B.T.E.). In charge of Quality Testing Division, Shanghai Bureau of Inspection and Testing of Commercial Commodities, Shanghai, China.

Lamb, Arthur Franklin, II, '10 (D). In business, Cleansing and Dyeing, Rockland, Maine.

Lamont, Robert Laurence, II, '12 (D).

Lamprey, Leslie Balch, IV, '16 (B.T.D.). 18 Holton Street, Lawrence, Mass.

Lamson, George Francis, I, '00 (D). 117 Westford Circle, Springfield, Mass.

Lane, John William, I, '06 (C).

Lane, Oliver Fellows, IV, '15 (B.T.D.). Chemist, Head of Color Making Department, Lowe Paper Company, Ridgefield, N. J.

Larratt, John Francis, II, '22 (D). Glenark Mill, Woonsocket, R. I.

Laughlin, James Knowlton, III, '09 (D).

Laurin, Eric Thursten Lawrence, IV, '21 (B.T.C.). Chemist and Colorist, Sayles Finishing Plant, Saylesville, R. I.

Laurin, Sven Albert, IV, '23 (B.T.C.). Student, Boston University, Boston, Mass.

Leach, John Pelopidas, I, '00 (C). Farming, Mosby Hall Farm, Littleton, N. C.

Leavitt, George Herbert, II, '26 (D). Inspector, F. C. Huyck & Sons, Albany, N. Y.

Lee, William Henry, II, '05 (C). Manager, Graves Hall & Co., Inc., New Haven, Conn.

Leitch, Harold Watson, IV, '14 (B.T.D.). Superintendent, Dyeing and Finishing, Pacific Mills, Lawrence, Mass.

Lemire, Joseph Emile, VI, '21 (B.T.E.). Mathematics Instructor, Lowell High School, Lowell, Mass.

Leonard, Leo Edward, I, '27 (D). Designer, Worcester Textile Company, Valley Falls, R. I.

Levi, Alfred Sandel, IV, '09 (D). Vice-President, Liondale Bleach, Dye and Print Works, Rockaway, N. J.

Lewis, George Kenneth, VI, '24 (B.T.E.). Development Division, Du Pont Rayon Company, Empire State Building, New York City.

Lewis, LeRoy Clark, IV, '08 (D). Raw Silk Broker, 404 Fourth Avenue, New York City.

Lewis, Walter Scott, IV, '05 (D). West Falls, Church, Va.

Lifland, Abraham, IV, '31 (B.T.C.). Assistant Dyer, Artistic Dyeing Company, Brooklyn, N. Y.

Lillis, Marvin Hale, IV, '14 (D). With Marland Mills, Andover, Mass.

Lindsly, Walter Coburn, IV, '29 (B.T.C.). Textile Chemist, Bigelow Sanford Carpet Company, Thompsonville, Conn.

Linsey, Edward, II, '25 (D). 140 Boylston Street, Malden, Mass.

Logan, George Leslie, VI, '28 (B.T.E.). Assistant to General Manager, Tompkins Brothers Company, Syracuse, N. Y.

Lombard, Carleton Joshua, VI, '23 (B.T.E.). Salesman, Rodney Hunt Machine Company, Orange, Mass.

Loney, Robert William, II, '22 (D). 13 Pearl Street, Amsterdam, N. Y.

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Loveless, Everton Hanscom, VI, '31 (B.T.E.). Cotton Division, Pacific Mills, Lawrence, Mass.

Lowe, Philip Russell, VI, '24 (B.T.E.). Inspector, Associated Factory Mutual Fire Insurance Companies, Boston, Mass.

Lucey, Edmund Ambrose, II, '04 (D). Consulting Engineer, 53 Park Place, New York City and South Manchester, Conn.

Lussier, Joseph Adrien, II, '27 (D). Staff Superintendent, Hood Rubber Company, Inc., Watertown, Mass.

McAllister, Gordon Algeo, IV, '31 (B.T.C.). North Billerica, Mass.

McCann, John Joseph, Jr., VI, '24 (B.T.E.). 90 Beech Street, Lowell, Mass.

McCool, Frank Leslie, IV, '10 (D). Dyestuff Salesman, Sandoz Chemical Works, Inc., 930 New Industrial Trust Building, Providence, R. I.

McDonald, Gerald Francis, IV, '30 (B.T.C.). With Merrimack Hat Corporation, Amesbury, Mass.

Macdonald, Hector Graham, IV, '19 (B.T.C.). Superintendent of Dyeing, Franklin Process Company, Providence, R. I.

McDonnell, William Henry, I, '06 (C). Lawyer, McDonnell & White, 40 Court Street, Boston, Mass.

McGee, Francis Patrick, IV, '30 (B.T.C.). Assistant Chemist, Bates Manufacturing Company, Lewiston, Maine.

McGowan, Frank Robert, VI, '15 (B.T.E.). Wool Technologist, Bureau of Agricultural Economics, Department of Agriculture, Washington, D. C.

McGowan, Henry Earl, VI, '22 (B.T.E.). Instructor, Lowell High School, Lowell, Mass.

McGuire, Edward Perkins, VI, '28 (B.T.E.). With James McGreery & Co., 5th Avenue and 34th Street, New York City.

Mackay, Stewart, III, '07 (D). Assistant Professor of Textile Design, Lowell Textile Institute, Lowell, Mass.

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McLean, Earle Raymond, IV, '30 (B.T.C.). Industrial Fellow, Mellon Institute of Industrial Research, University of Pittsburgh, Pittsburgh, Pa.

MacPherson, Wallace Angus, III, '04 (D). Designer, Wuskanut Mills, Inc. (S. Slater & Sons), Farnumsville, Mass.

Macher, Henry, II, '23 (D). 325 Divas Line Road, Passaic, N. J.

Maguire, James Joseph, II, '28 (D). Assistant Designer, Glenark Mill (Uxbridge Worsted Company), Woonsocket, R. I.

Maher, Margaret Mary, IV, '31 (B.T.C.). Color Matching and Laboratory Assistant, Hub Hosiery Mills, Lowell, Mass.

Mahoney, George Stephen, VI, '22 (B.T.E.). Superintendent, Franklin Cotton Mill Company, Cincinnati, Ohio.

Mailey, Howard Twisden, II, '08 (D). Manufacturing Superintendent, Worsted Manufacturing, Pacific Mills, Lawrence, Mass.

Manning, Frederick David, IV, '10 (D). Planning Department, Pacific Mills, Lawrence, Mass.

Marinel, Walter Newton, I, '01 (D). Auto Mechanic, North Chelmsford, Mass.

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Mather, Harold Thomas, VI, '13 (D). Inspector, Associated Factory Mutual Fire Insurance Companies, Boston, Mass.

Mathieu, Alfred Jules, II, '20 (D). Salesman, Wools and Commission Dyeing, Woonsocket, R. I.

Matthews, Elmer Clark, II, '17 (D). Superintendent, Thermo Mills, Inc., West Sand Lake, N. Y.

Matthews, Robert Jackson, VI, '29 (B.T.E.). Salesman, Pacific Mills, 300 West Adams Street, Chicago, Ill.

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Meadows, William Ransom, I, '04 (D). Cotton Registrar, Chicago Board of Trade, Chicago, Ill.

Meek, Lotta, IIIb, '07 (C). See Parker, Mrs. Herbert L.

Meeker, Samuel, IV, '27 (B.T.C.). Chemist, Textile Dyeing & Printing Company of America, Hawthorne, N. J.

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Molloy, Francis Henry, II, '16 (D). With The William Carter Company, New York City.

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Moore, Karl Remick, IV, '11 (D). Production Engineer, Washington Mills, Lawrence, Mass.

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Morrill, Howard Andrew, VI, '16 (D).

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Murray, James Andrew, II, '10 (D). President, Murray Chocolate Company, 162 Commercial Street, Boston, Mass.

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O'Donnell, John Delaney, I, '04 (C).

O'Hara, William Francis, IV, '04 (C).

Olson, Carl Oscar, II, '24 (D). Scheduling Department, Cheney Brothers, South Manchester, Conn.

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A STUDY OF SINGLE AND TWO-PLY WORSTED YARNS

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The material for this paper is selected from two theses performed under the direction of the Textile Engineering Department by Edward W. Tamulonis, 1930, and Joseph Glowacki, 1932, during their senior year and as a requirement for the degree of Bachelor of Textile Engineering.

The purpose of the studies was to compare the properties of single and two-ply worsted yarns of different counts manufactured from the same material. There is reproduced here some of those comparisons which it is believed will be most valuable, namely, those dealing with breaking strength and elongation.

The material used was a 64/66s quality wool of 5½″ staple, purchased from a nearby mill in the form of 42½ dram slubbing. By suitable layouts this was reduced and finally spun on a cap frame into eight different counts of single yarn ranging from 12s to 60s and with the twists per inch (R.H.) shown in Table 1. Each lot of singles was divided into two approximately equal parts, one being reserved for the single yarn tests, while the other was made into two-ply yarns with the twists per inch (L.H.) shown in Table 1.

The testing procedure closely conformed to that specified by the A.S.T.M. and care was exercised to properly condition the material for at least three hours before testing. The actual counts were determined from twenty 80-yard skeins, two from each of ten different bobbins. The values given for twist per inch, breaking strength, and elongation are the averages of two hundred individual tests in each case, twenty from each of ten different bobbins. In addition to these, one half as many multistrand tests were made for strength and elongation, the results of which are not given but which confirm the single strand data.

Some of the results are presented in graphical form with only such comments as limited space permits. In all cases the abscissae of points represent actual counts. In ply yarn data, they represent equivalent single counts.

PLOT A — This shows the rapid increase in breaking strength in grams with decrease in counts of the yarn. The rate of increase for the ply yarns in the region from 12s to 26s is slightly greater than that for the singles. The strength of the ply yarns is greater than that of the singles of equivalent count. Since the cross sectional area of a yarn is proportional to the reciprocal of the counts, a plot of the latter (drawn dotted) is inserted to show the theoretical change in strength which should occur with change in size of the yarn. It will be noted that the singles curve very closely parallels it.

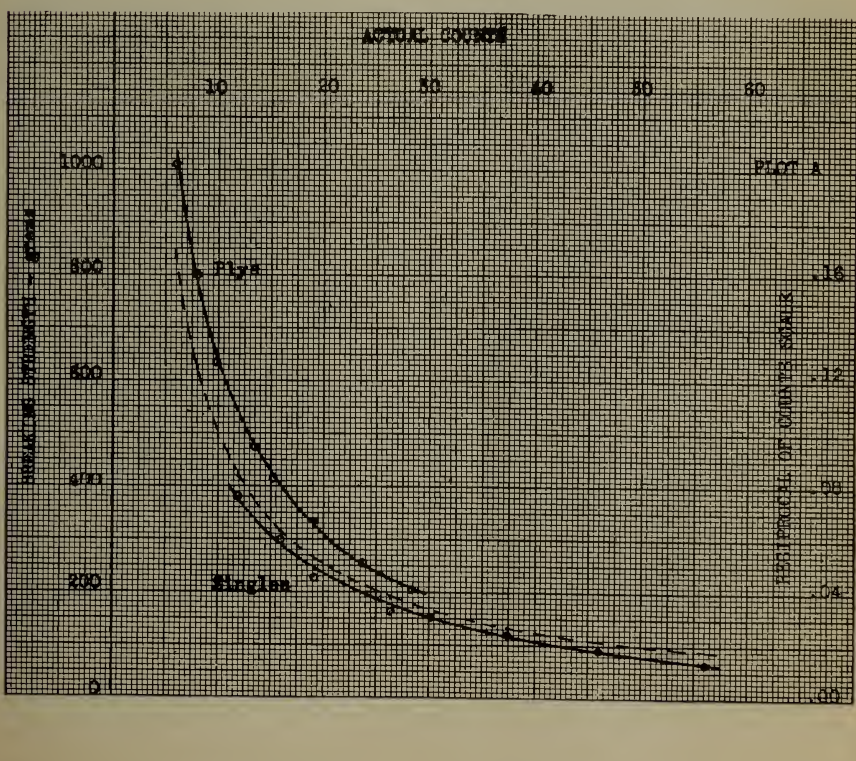
PLOT B — This plot of strength factor (strength x counts), a quantity which is proportional to the breaking unit stress, shows a fairly constant value of 4500 for the single 12s to 32s, and of 6300 for the two-ply 6s to 16s. For finer counts the factor gradually decreases, the rate for the ply yarn being slightly greater than that for the single.

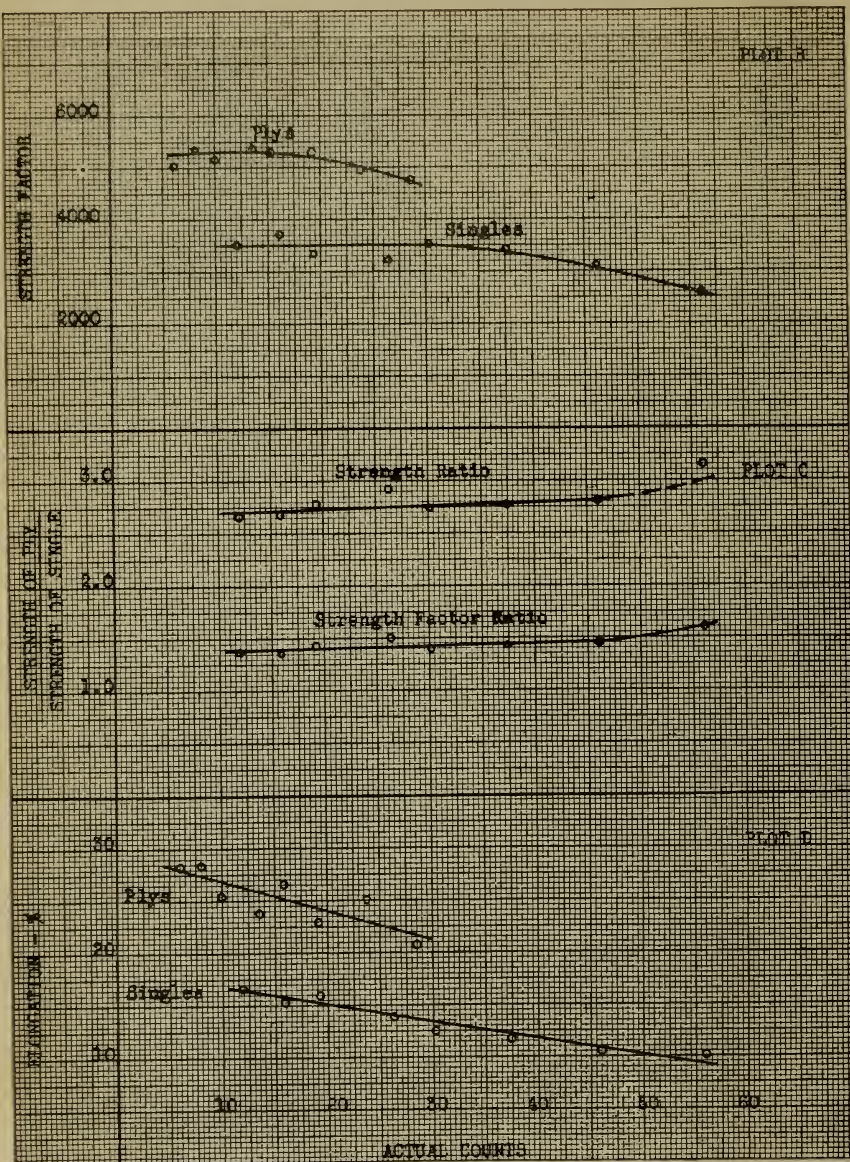
PLOT C — This shows the ratio between the strength of a ply yarn and that of the single from which it is made. The upper line is based on the breaking strength in grams and indicates that the strength of the ply yarns averaged 2.75 times that of the singles, except in the case of the 2/60s for which the ratio exceeds 3.00. The lower line, based on strength factor, shows that the unit stress in the ply yarn was about 1.4 times that in the single, with a tendency to increase in the finer counts.

PLOT D — The lines in this plot express uniform rates of decrease in percent elongation for increase in counts. The rate for the ply yarn is 2.9% per 10 counts, and that for the singles is 1.5% per 10 counts.

TABLE I — SUMMARY OF DATA

Nominal Counts	Actual Counts	Twist per Inch	Breaking Strength Grams	Strength Factor	Elongation %
		Single Yarns			
12	11.9	6.8	380.1	4525	16.6
16	15.9	8.1	298.3	4740	15.4
20	19.2	8.7	227.5	4370	15.9
26	26.3	10.4	161.7	4250	13.9
32	30.1	12.1	151.3	4560	12.5
40	37.4	14.5	119.6	4470	11.7
50	46.0	16.1	89.6	4120	10.5
60	56.0	18.9	64.7	3620	10.1
		Ply Yarns			
2/12	6.0	6.7	1011.1	6060	28.2
2/16	8.0	8.5	799.2	6390	28.3
2/20	9.8	8.7	632.1	6190	25.4
2/26	13.5	11.2	473.7	6390	23.8
2/32	15.2	13.0	415.2	6320	26.5
2/40	19.1	14.8	332.0	6340	22.8
2/50	23.7	19.0	252.4	5980	25.0
2/60	28.4	18.5	203.6	5790	20.7




PLOT B
STRENGTH FACTOR
6000
4000
2000
Plys
Singles
PLOT C
STRENGTH OF PLY
STRENGTH OF SINGLE
3.0
2.0
1.0
Strength Ratio
Strength Factor Ratio
PLOT D
ELONGATION - %
30
20
10
Plys
Singles
10
20
30
40
50
60
ACTUAL COUNTS

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BULLETIN

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Moody Street and Colonial Avenue

DEPARTMENT
OF
LOWELL TEXTILE SCHOOL

Publication of this Document approved by the Commission on Administration and Finance.
2M. 7-'32. Order 5960

LOWELL EVENING TEXTILE SCHOOL.

By Act of the Legislature of 1928, the name of the Lowell Textile School was changed to Lowell Textile Institute, and the evening classes are organized and are to be hereafter operated as a department of the Institute to be known as the Lowell Evening Textile School.

CALENDAR.

1932.

September 22, Thursday	Registration.
September 29, Thursday	Registration.
October 3, Monday	Opening of evening school.
November 24, Thursday November 25, Friday	Thanksgiving recess. No classes.
December 20, Tuesday	End of first term.

1933.

January 5, Thursday	Opening of second term.
March 3, Friday	Closing of evening school.
April 4, Tuesday	Graduation.

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Vittoria Rosatto . . . . 63 Bradstreet Avenue.
Evening Instructor in Freehand Drawing.
J. Raymond Bradley . . . . 29 Paige Street.
Evening Instructor in Show Card Design.

EVENING CLASSES

GENERAL INFORMATION.

Entrance Requirements

All applicants to the evening classes must understand the English language and simple arithmetic. Those who are graduates of a grammar or high school are admitted upon certificate. Those who cannot present such a certificate are required to take examination in the subjects of English and arithmetic. In the examination in English a short composition must be written on a given theme, and a certain amount must be written from dictation. In the examination in arithmetic the applicant must show suitable proficiency in addition, subtraction, multiplication, division, common and decimal fractions, percentage, ratio and proportion. Opportunity to register or to take these examinations is offered each year, generally on the Thursday evenings of the two weeks previous to the opening of the evening school.

Registration

Before entering the class a student must fill out an attendance card, which can be obtained at the office or from the instructors in the various departments.

Any student who has filed an attendance card and who wishes to change his course must notify the office before making the change.

Sessions.

The evening classes commence the first Monday of October and continue for twenty weeks. The school is open on four evenings each week during the period mentioned, except when the school is closed for holiday recesses.

Supplies.

Students must provide their own books, stationery, tools, etc., and pay for any breakage or damage that they cause.

Students' supplies will be sold from the co-operative store every evening school night from 6.45 to 8.15 P.M.

Fees and Deposits.

All evening courses are free to residents of Lowell. To those outside of Lowell the fee is $10 per year for *each course of two nights per week.* Students taking two courses or attending courses requiring more than two nights per week are required to pay $15 per year for three nights and $20 for four nights.

All fees and deposits must be paid in advance.

All students, whether from Lowell or not, taking Course 411, Chemistry and Dyeing Department, are required to make a deposit at the commencement of the course—$5 for first-year students, and $10 for second-year students. A deposit of $10 will be required of all students taking Course 412, 413 or 414. This is to cover the cost of laboratory breakages, chemicals, apparatus, etc., and at the end of the year any unexpended balance is returned, or an extra charge made for the excess breakage.

Every student who takes the chemistry and dyeing course must check up his desk with the instructor of that department when he leaves the school. Any student not doing so will be charged 50 cents.

All students taking Machine-Shop Practice will be required to make a deposit of $5. Any unexpended balance remaining at the end of the year will be returned to the student.

Report of Standing.

A report of standing covering the year's work is sent to all students who attend the entire year and take the necessary examinations.

Certificates.

The courses of the evening school are varied and arranged to meet the special needs of those engaged in the industry. They vary in length from one to four years, and at the completion of each course the certificate of the school is awarded, provided, however, that the student has been in attendance in the course during the year for which the certificate is granted.

GENERAL EVENING COURSES

The object of these courses is to give young men of ambition an opportunity to obtain instruction in all the branches of science that are allied with their daily work. For example, one who is employed as a weaver in a textile mill may obtain knowledge of the manufacture of yarn, the production of a design, and the methods of finishing a fabric, as well as the manner of its weaving or knitting. In like manner the dyer may augment his knowledge of the chemicals and materials he is daily handling. The engineer and machinist may acquire a knowledge of the mathematics, science of mechanics, electricity and drawing that underlie all the work of an engineer.

It is recognized that the interests of such students lie in a particular field of industry, and these courses are designed to bear directly upon the special line, and supplement, as far as possible, the practical work in which the student is engaged during the day.

In a word, any man having a common school education and the ambition to advance in his line may now secure a broad and comprehensive training in the subjects which will be of vital importance to him in obtaining the goal of his ideal.

A description of all courses follows.

COTTON DEPARTMENT.

110. Cotton Yarns—3 Years.

The *first year* work in cotton yarn manufacture consists of a study of cotton and its preparation for market, followed by a study of opening, picking, carding and combing. This work consists of lectures on these operations combined with problems that are peculiar to each operation such as the drafts used and the production of each process as well as the amounts of waste made. Special consideration is given to the adjustment and care of these machines and some laboratory demonstration is used to show the manner of adjusting machines for the purpose of controlling the weight of the product, the amount of work done in a day and the control of waste.

Two evenings per week.

Cotton.—Before taking up the details of manufacturing cotton into yarn, a careful study of its physical characteristics is made. The geographical distribution of the areas producing commercial cottons is explained and the characteristics of the cottons produced in each are studied. A general explanation of the cultivation and harvesting of cotton is made, especially emphasizing the effect of agricultural factors on the cotton fiber and how these may serve to complicate manufacturing problems.

The ginning of cotton is considered, showing the yield of lint, the uses of cotton seed and the various types of gins and which cottons are commonly ginned on each.

The intricate system of buying and selling cotton is studied to illustrate the problems a mill may meet in procuring cotton. In this connection, special emphasis is placed on the classification of cottons by staple and by grade.

Opening and Picking.—Instruction in the preliminary operation of opening and picking covers the mechanical construction of the machines, their parts and adjustments, as fully as the manufacturing results accomplished by the machines. This includes such construction details as evener, lap measuring and safety stop motions, grids, cleaning trunks and beaters, also operation details which involve the adjustment for waste, drafts and character of laps. Some time is devoted to mixing in its various phases, showing in addition to improvement in uniformity of the product, how cottons are mixed to obtain definite average prices and how different percentages of color may be obtained by mixing, expecially on the pickers.

Carding.—The process of carding is considered one of the most important, and proper time is devoted to the construction and operation of cards that the student may be familiar with the various parts of the card and the function and design of each. The construction and application of card clothing, as well as the methods of grinding, form a part of the work. Some time is given to a discussion of the waste made in carding, the regulation of the amounts of each made and the calcu-

lation of the percentages. New and special attachments for various purposes are brought to the attention of the class, illustrating possible ways of improving carding conditions.

Combing.—The preparation of card sliver for combing by means of the sliver lapper and ribbon lapper is thoroughly considered. The combing operation itself is studied in considerable detail, emphasizing the general object and operations in combing and the specific means employed by various types of combs in performing the operations. The calculations in this connection involve the drafts and doublings necessary to produce the proper lap for the comb, the proper comb drafts, and the determination of the per cent of noil produced.

The *second year* work includes a study of the drawing and roving processes and the calculations that accompany these operations. It consists of lectures on the machines and demonstration of their adjustment, showing roll setting, draft and twist control, builder adjustment, spacing coils on the bobbin, and tension control.

One evening per week.

Drawing.—Under this head is taken up the theory of doublings and their effect upon the quality of roving and yarn. Like previous and subsequent processes the machine construction forms an important part of the work. Proper stress is paid to such subjects as stop motions, drawing rolls and their covering, clearers and evener motions.

Roving Process.—Under this head are studied the various machines known as the slubber, intermediate, fine and jack fly frames. Each of the various motions of these complicated machines is treated separately and then the group is taken as a unit, tying each operation in with the others. Particular attention is paid to the subjects of lay and tension because of their importance in producing perfect roving. The calculations in this subject involve draft, twist, lay and tension with particular attention to the derivation of constants and their use.

During the *third year* the time is devoted to a study of ring and mule spinning, spooling, winding, twisting and reeling, instruction being given by means of lectures and demonstrations. There is also some work done on the combing machine, particularly in the nature of its adjustment. In addition to these subjects, some time is spent on planning the organization of a cotton mill with a view to showing drafts, speeds, productions and number of machines of each kind necessary for the production of a given amount of a certain yarn.

Two evenings per week.

Ring Spinning.—The consideration of spinning yarn by the ring frame method involves a knowledge of the uses to which the yarn is to be put and subsequent methods of handling, that proper roving may be selected, suitable amounts of draft and twist provided, correct size of rings and travelers selected, and building motions suitably adjusted. Yarn defects are studied with reference to the cause and remedy, necessitating references to many of the earlier operations.

Mule Spinning.—This method of spinning is very different from that of the ring frame, and the mechanical details are more complicated. The student is furnished with a new means of producing yarns, and can compare the relative advantages of each method. A thorough understanding of mule spinning is perhaps more a study of mechanical motions and their functins. This results almost invariably in assisting the student to understand previous processes and machines better because of his work on the mule. It is the object to make clear to the student's mind the principles underlying the construction and operation of the parts that control the drawing, twisting, backing off and winding, together with such special motions and devices as are used upon the modern mule.

Spooling and Winding.—The discussions under this head cover the treatment of single yarns, ring or mule spun, in preparation for twisting, comparing the relative merits of spooling with multiple winding on tubes, and beaming for special twisters. Winders are also considered as a means of preparing yarn packages for sale yarns.

Twisting.—Because of the similarity to ring spinning, the emphasis is more on the manufacturing part of the work, although there are a few peculiar features of a mechanical nature. The twisting of various regular ply yarns, the making of

numerous fancy yarns and the principles underlying the production of unlimited patterns is taken up here. The use of special twisters and other apparatus for cords and ropes is considered at this point.

WOOLEN AND WORSTED DEPARTMENT.

210. Worsted Yarns—2 Years.

During the *first year* instruction consists of a lecture course on the various kinds of wool fibers, trade terms, sorting, scouring, carbonizing, etc., also a course in carding and the calculations involved in the mechanism of the machines, and a course covering gilling and combing and the processes of top making.

Raw Materials.—A study of raw materials which enter into the manufacture of woolen or worsted yarns, or are made into yarns by processes similar to those employed in the manufacture of woolen and worsted yarns, would include silk, mohair, alpaca, vicuna, cashmere, camel's hair and cotton. In connection with these are considered shoddy, noils and extracts.

Wool Sorting.—Familiarity with the various grades and kinds of wool is obtained by lecture. The various characteristics and properties are explained, as are also trade terms, such as picklock, XXX, XX, ½-blood, ⅜-blood, ¼-blood, delaine, braid, etc. Some skill is acquired in the estimation of shrinkage and in judging the spinning qualities.

Wool Scouring.—The object of scouring and the methods employed are explained, and this involves the consideration of soaps and chemicals used in washing; also the waste products and their utilization. A demonstration of a commercial quantity of wool is scoured by machines that are made similar in operation to regular commercial machines. A study is made of the effect of the hardness of water upon soap. At the same time the use of driers, their operation and regulation, is taken up, and the methods of carbonizing wool, noils, burr waste, rags, etc., are studied and explained.

Carding.—The different systems of carding wool, depending on whether it is to be made into woolen or worsted yarns, are fully explained, as is also the construction, setting and operation of cards. A part of this work consists of a study of card clothing, its construction, application and grinding.

Top Making and Combing.—This branch takes up, besides the carding of the wool on a worsted card, the preparing processes, backwashing, also gilling of the stock before and after combing. The construction of the gill boxes and combs is studied by lectures. Later, quantities of stock are made into top and then into yarn.

Three evenings per week.

The *second year* is devoted to detail study of the English and French systems of worsted yarn manufacture.

The Noble, Lister and French combs are studied, and the various calculations to determine draft, noiling, productions, etc., are made.

Drawing and Spinning.—The equipment in the laboratory offers opportunity to make worsted yarn by either the Bradford or open drawing system or by the French system. The process includes the various machines in the successive steps of making Bradford spun yarn, and the functions of the different machines are studied. In the latter, or French system, the stock is run through the drawing machines, and the roving spun into yarn on the worsted mule. The same method of studying the mechanism and operations of these machines is followed as in the case of previous methods of instruction. The student by pursuing this course can compare the different methods of yarn manufacture and note the results of each.

With the instruction in spinning by the Bradford system is given work on the twisters and the effects that may be produced.

Three evenings per week.

211. Woolen Yarns—2 Years.

During the *first year* instruction consists of a lecture course on the various kinds of wool fibers, trade terms, sorting, scouring, carbonizing, etc., also of a course on carding, and the calculations involved in the mechanism of the machines.

Two evenings per week.

The *second year* continues the instruction on carding and then takes up a course on the mule and woolen yarn spinning.

Burr Picking, Mixing, Oils and Emulsions.—The use of burr pickers in cleaning wool and the use of mixing pickers in making color blends is covered by lecture and demonstration. Under the subject of oils and emulsions are taken up the characteristics of various oils and the means employed to test them.

Woolen Mule.—The student studies thoroughly the operation of the mule as a whole, and acquaints himself with the various principal mechanisms, as, for example, the backing off and winding motions, the quadrant, builder-rail, faller regulation, etc.

Two evenings per week.

TEXTILE DESIGN AND WEAVING DEPARTMENT.

311. Cotton Design—3 Years.

During the *first year* instruction is given in elementary designing, starting with all the foundation weaves which may be used in fabrics such as the plain weave, rib weaves, basket weaves, twill weaves, satin weaves, granite weaves, etc. Combination and derivative weaves are made up from the aforesaid weaves. Fancy and figured weaves, in most cases originated by the student, are produced. Color effects, which are so essential in fabrics, obtainable from the different weaves, as stated above, in which the color arrangement of warp and filling create the pattern, are thoroughly considered. Not only the designing, but also harness drafting and the making of dobby chains for any type of weave is taken up.

Cloth analysis is considered in conjunction with designing, as a designer must know the kind of fabric he is designing, what material and what size of yarns are to be used, and how heavy and costly the cloth is to be. The various topics discussed are the sizes or counts of yarns made from all kinds of fibers, such as cotton, woolen, worsted, silk, rayon, jute and yarns of other vegetable fibers. Their relative length to the pound is determined in the single two or more ply, mixed yarns, novelty yarns and fancy yarns, in the American or English system. The same is given in the metric system. Problems involving the take-up of yarns in the weaving and finishing process are given. Samples of cloth are picked apart to determine their weaves and general construction.

Two evenings per week.

In the *second year* cloth analysis and design are combined in lecture and practice, starting with plain and leading into the more fancy cotton dobby fabrics. A great variety of samples of cloth are used in class work to determine ends and picks per inch, shrinkage in warp and filling, and the number of reed and reed widths necessary for eventual reconstruction. The yarn numbers of warp and filling are determined by aid of fine balances. The amount of warp and filling necessary for a piece of goods is calculated and the weight of a whole piece as well as the number of yards per pound are determined.

Two evenings per week.

In the *third year* more elaborate cloths are considered, both in designing and analysis, cloths in which extra warp or extra filling, or both, are used. Warp backed, filling backed, double, triple or more plied fabrics are taken up, such as marseilles, quiltings, pique, suspenders, narrow webbings, velveteens, fancy velveteens, velvets, corduroys, Bedford cords, plushes, leno, in fact, anything a student may suggest which might help him in his work.

Two evenings per week.

312. Woolen and Worsted Design—3 Years.

This course covers the design and analysis of standard woolen and worsted fabrics and is intended for those who wish to specialize in this branch of textile fabric manufacture. Special and fancy fabrics are studied to the extent that time will permit.

During the *first year* instruction is given in the subject of classification of fabrics, use of points or design paper, plain fabrics, intersection, twills and their derivation, sateen, basket and rib weaves, checks and stripes, fancy weaves, including figured

and colored effects; producing chain and draw from design, and *vice versa*; extending and extracting weaves.

The analysis of samples is taken up in a systematic manner, illustrating the various cloth constructions for the purpose of determining the design of the weaves and the amount and kind of yarns used, and forms the basis of calculation in the cost of reproducing any style of goods. The various topics discussed are reeds and setts; relation and determination of counts of cotton, woolen, worsted, silk and yarns made from the great variety of vegetable fibers; grading of yarns, folded, ply, novelty and fancy yarns; application of the metric system to yarn calculation; problems involving take-up, average counts, determination of counts of yarn, and weight of yarn required to produce a given fabric.

Two evenings per week.

During the *second year* instruction is given in cotton warp goods, blankets, bath robes, filling reversible, extra warp and filling backs, figured effects produced by extra warp and filling, double cloths and plaid backs.

The analysis work follows as closely as possible the type of fabrics taken up in the designing and the reconstruction of these fabrics with the consideration of their shrinkage and composition.

Two evenings per week.

In the *third year* instruction is given in multiple fabrics, chinchilla, Bedford cords, crepon, matelasse and imitations, double plains, meltons, kersey, plush and suitings. At this time also is taken up the construction of designers' blankets, suggestion cards, and the construction of samples.

The construction of new fabrics from theoretical viewpoint together with the construction from suggestion cards is taken up. In connection with this work instruction is given in making cost estimates for both woolen and worsted fabrics.

Two evenings per week.

314. Cotton Weaving—1 Year.

The Course in Cotton Weaving covers instruction on plain looms, Draper Automatic and Stafford Automatic looms. It includes instruction on the construction of shedding and picking motions, take-up and let-off motions together with the operation of the magazines and hoppers and methods of changing shuttle and bobbin. A study is also made of the preparation of warps, beaming, sizing and drawing-in. The Crompton and Knowles Automatic Towel Looms, and the various types of box looms, including chain building and work on multipliers, are also considered in this course.

One evening per week.

315. Woolen and Worsted Weaving—2 Years.

This course includes instruction on the Crompton and Knowles loom and takes up general construction, head motions, take-up, let-off, filling stop motion, etc. The preparation of warps, wet and dry dressing, is given in connection with this course.

One evening per week.

316. Dobby and Jacquard Weaving—1 Year.

This course considers the various types of Jacquard heads and dobbies, which includes single cross border dobbies and leno attachments on double lift dobbies, handkerchief motions, leno weaving, center selvedge motions, filling changing looms, oscillating reeds, lappet motions, various shaker motions, towel and other pile cloth weaving. The course on Jacquard looms includes general construction, card cutting, lacing, repeating and fixing.

One evening per week.

317. Freehand Drawing—3 Years.

The *first year* work consists of charcoal drawing from casts, models, and group arrangements of still life.

Two evenings per week.

During the *second year* instruction is given in pencil sketching, colors, charts and color harmony, pen and ink drawing, and development of original motifs from various sources with color application.

Two evenings per week.

The *third year* work covers original designing for textile fabrics, wall paper and book cover work, pastel and water colors, and oil painting when the time will permit.

Two evenings per week.

318. Show Card Design—2 Years.

During the *first year* the student is taught to master the drawing, with pencil, of a few very plain alphabets, both upper and lower case letters, also plain figures. With the characteristics of plain letter alphabets well in mind, it is but a few steps to make any of the more intricate ones. Following this he will make simple "lay-outs" of plain card signs, and then take up the lettering, with brush and paint, of some of his simple card designs.

Two evenings per week.

The *second year* is simply a continuation of the latter part of the first year work, with the addition of advanced design in the "lay-out" and color-scheme of practical show cards and posters, such as are designed and lettered in the up-to-date Show Card Shop of to-day.

Two evenings per week.

CHEMISTRY AND DYEING DEPARTMENT.

Hardly any branch of applied science plays so important a part in our industrial world as chemistry. Many large mills employ chemists as well as dyers, and with the great progress which is being made in the manufacture and application of dyestuffs, a basic knowledge of chemistry becomes an absolute necessity to the dyer. Within a comparatively short distance from Lowell are establishments employing men who require some knowledge of chemistry but who may not necessarily use dyes. Some find a knowledge of analytical chemistry helpful in their everyday work.

To meet these varying needs of our industrial community, the school offers a two-year course in general chemistry, organic and inorganic, which may be followed by any one of three courses, viz., textile chemistry and dyeing, analytical chemistry, and textile and analytical chemistry. In order to take Course 412, 413 or 414, candidates must have a certificate from Course 411, or show by examination or approved credentials that they have taken the equivalent of the work covered by this course.

411. Elementary Chemistry—2 Years.

General Chemistry, including Inorganic and Organic.

Qualitative Analysis.

One lecture and one Laboratory Period per week in General Chemistry the first year, continued three nights a week during the second year, when the Elementary Organic Chemistry and Qualitative Analysis is completed.

Instruction in Elementary Chemistry extends through two years, and includes lectures, recitations and a large amount of individual laboratory work upon the following subjects:—

Theoretical Chemistry.—Chemical action, chemical combination, combining weights, atomic weights, chemical equations, acids, bases, salts, Avogadro's law, molecular weights, formulæ valence, periodic law, etc.

Non-Metallic Elements.—Study of their occurrence, properties, preparation, chemical compounds, etc.

Metallic Elements.—Study of their occurrence, properties, metallurgy, chemical compounds, etc.

The students take up, as thoroughly as time will permit, the qualitative detection of the more common metals and non-metals, with practical work.

This work, although necessarily elementary, is intended to prepare the student to study more understandingly the manufacture and coal tar colors in the more advanced courses which follow.

During the *first year* of the Elementary Chemistry course most of the time is devoted to the non-metals and theoretical chemistry, and the laboratory work covers briefly the non-metals.

Two evenings per week.

During the *second year* the classroom work is upon metals and the hydrocarbons and their derivatives, and the laboratory work consists entirely of Qualitative Analysis. While this course is necessarily taken up in an abbreviated and elementary manner, it is so arranged that the students may become familiar with the separations and the detections of the common metals and acids. This course is also preliminary to the work given in Analytical Chemistry.

Three evenings per week.

412. Textile Chemistry and Dyeing—3 Years.

Lectures in Textile Chemistry and Dyeing.

Laboratory Work in Dyeing.

Covered by 60 lectures and two nights of laboratory work per week.

The outline of the lecture course given in Textile Chemistry and Dyeing is as follows:—

Technology of Vegetable Fibers.—Cotton, linen, jute, hemp, china grass. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Animal Fibers.—Wool, mohair, silk. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Artificial Fibers.—Study of the various forms of artificial silk, the process of manufacture, their properties and action with chemicals, acids and heat.

Operations Preliminary to Dyeing.—Bleaching of cotton and linen; wool-scouring; bleaching, fulling and felting of wool; carbonizing; silk-scouring and bleaching, action of soap.

The bleaching of cotton is studied with description of the various forms of kiers and machinery used; also the action of the chemicals used upon the material, and the various precautions that must be taken in order to insure successful work.

Under this heading is included a study of the reagents used in the emulsive wool-scouring process, and their action upon the fiber under various conditions; also the most successful of the solvent methods of degreasing wool.

Water and its Application in the Textile Industry.—Impurities present, methods for detection, their effect during the different operations of bleaching, scouring, dyeing and printing, and the methods used for their removal or correction.

The important subject of boiler waters is also studied under this heading, with a full discussion of the formation of boiler scale, its disastrous results, and the methods by which it may be prevented.

Mordants and Other Chemical Compounds used in Textile Coloring, and Classified as Dyestuffs.—Theory of mordants, their chemical properties and application, aluminum mordants, iron mordants, tin mordants, chromium mordants, organic mordants, tannin materials, soluble oil, fixing agents, leveling agents, assistants, and numerous other compounds not dyestuffs that are extensively used in the textile industry.

Under this heading are included the definitions of various terms and classes of compounds used by textile colorists, such as color lakes, pigments, fixing agents, developing agents, mordanting principles and leveling agents.

Natural Organic Coloring Matters.—Properties and application of indigo, logwood, catechu or cutch, Brazil wood, cochineal, fustic, tumeric, madder, quercitron bark, Persian berries, and other natural dyestuffs that have been used in recent years by textile colorists.

Mineral Coloring Matters.—Under this heading are discussed the properties of such inorganic coloring matters and pigments as chrome yellow, orange and green, Prussian blue, manganese brown, iron buff.

Artificial Coloring Matters.—General discussion of their history, nature, source, methods of manufacture, methods of classification and their application to all fibers.

Besides lectures and recitations upon the subject of Textile Chemistry and Dyeing, practical laboratory work is required. By the performance of careful and systematic experiments the student learns the nature of the various dyestuffs and mordants, their coloring properties, their action under various circumstances, and the conditions under which they give the best results. The more representative dyestuffs of each class are applied to cotton, wool and silk, and each student is obliged to enter, in an especially arranged sample book, a specimen of each of his dye trials with full particulars as to the conditions of experiment, percentage of compounds used, time, temperature of dye baths, etc.

For convenience and economy most of the dye trials are made upon small skeins or swatches of the required materials, but from time to time students are required to dye larger quantities in the full-sized dyeing machines.

413. Analytical Chemistry—3 Years.

Laboratory Work and Lectures in Quantitative Analysis.

Three nights per week of class-room and laboratory work.

The object of this course is to give the student a general idea of the underlying principles of Analytical Chemistry, with a sufficient amount of laboratory work to enable him to become proficient in performing the ordinary routine analysis of the textile plant. Frequent recitations are held for the discussion of methods and the solution of stoichiometrical problems.

The work covered the first two years is based on Talbot's "Quantitative Analysis," and for the advanced work, consists of the analysis of soap, water, oils, cloth and other materials of particular interest to the textile chemist, special lecture notes and Griffin's "Technical Methods of Analysis" is used as a text.

414. Textile and Analytical Chemistry—4 Years.

Lectures in Textile Chemistry and Dyeing.

Laboratory Work in Analytical Chemistry.

Combines all lectures in Textile Chemistry and Dyeing with work of Course 413, but does not include any Dyeing Laboratory.

Three evenings per week.

TEXTILE ENGINEERING DEPARTMENT.

This department has arranged to offer those courses of study which lie at the foundation of all engineering. These are designed to give to those engaged in the mechanical, electrical, and manufacturing departments of mills, factories and other industrial establishments an opportunity to learn something concerning the theory underlying the many practical methods which they use in their daily work. Those subjects for which there is usually a regular demand are listed and described below, but similar and allied courses will also be arranged for provided there is a sufficient demand. In the case of all courses there must be an enrollment of at least ten properly qualified students to warrant giving the subject.

613. Mechanical Drawing—3 Years.

For one having occasion to make a sketch or detail drawing for the purposes of illustration or instruction, or for one who is daily required to work from a drawing or blueprint, the course in Mechanical Drawing is offered. It first lays a foundation of the principles of mechanical drawing, and follows this with two years' work in drawing directly from parts of machines, preparing both the detail and the assembly drawing.

This course is a complete course in drawing and requires *two evenings per week* for three years for its completion. The work is so planned that at its completion a man shall be thoroughly familiar with the making of a working or shop drawing. After a study of the underlying principles of projections and instruction in penciling, inking, lettering and tracing, the subject of sketching and the making of detail drawings therefrom is especially stressed. The preparation of assembly drawings is finally considered.

614. Machine Shop Practice—2 Years.

This course offers an opportunity to learn the art of metal working and is equally valuable to the man who already has some knowledge of the methods employed as to one who has no knowledge of the same. Thus it becomes possible for one who may be working at the bench during the day to learn how to operate a lathe or other machine tool, or for a lathe hand to acquire a knowledge of a planer, shaper, milling machine, or grinder. A series of lectures is given on the care and management of tools, tool grinding, and the mechanism of the machines. A man who only has a knowledge of the special machine he operates may by means of this course become a more intelligent machinist. He should supplement this study with the courses in Mechanical Drawing, and in Mechanics and Mechanism, in order that his training for an all-round machinist or mechanic may be more complete. The time required is *two evenings per week.*

619. Mechanics and Mechanism—2 Years.

This is one of the most important of engineering subjects dealing as it does with the principles which underlie the transmission of force and motion through machines and mechanical devices. Its principles are so fundamental and so widely used in more advanced subjects that the student should not consider himself qualified for further work until he has mastered the principles of this subject.

Beginning with a discussion of such important topics as work, power, horsepower, energy and the like, the student then studies the fundamental mechanical principles which are exemplified by the lever, jackscrew, pulley block, inclined plane, wedge, differential pulley and other similar devices. This is followed by consideration of the simpler relations pertaining to uniform and accelerated motion and the course concludes with a study of pulleys, belting, gears and gearing, as far as time permits. No student should undertake this course who is not thoroughly familiar with elementary mathematics. This subject requires attendance *two evenings per week* with home problem work and the study of a text book.

620. Mathematics—2 Years.

This course is designed to permit the student to pursue further by evening study the mathematics of his grammar or junior high school course. It includes algebra, elementary trigonometry, logarithms and slide rule, and requires attendance for *two evenings per week.* It should be taken by all who intend to study further into engineering subjects. Instruction is largely through problem work in class and at home, and the use of a text book.

Some of the topics treated are—

Elementary algebraic operations of—

- Addition.
- Subtraction.
- Multiplication.
- Division.
- Factoring.
- Fractions.
- Graphical representation.
- Linear equations.
- Radicals.
- Quadratic equations.
- Logarithms.
- Slide rule.
- Trigonometry.

621. Strength of Materials—1 Year.

This interesting subject deals with those important principles whereby the person engaged in machine, engine, mill or building design may ascertain whether the parts are strong enough to carry the forces and loads which the nature of the construction imposes upon them.

The fundamental stresses of tension, compression and shear are first considered, together with the ultimate strength of cast iron, wrought iron, steel, and timber. The practical use of this information is illustrated in the design of bolts, tie rods, columns, wall piers, boiler shells, riveted joints, etc. This is followed by a study of the stresses in and design of beams under various conditions of loading, and the course concludes with a discussion of the torsional stresses and twist in shafts. A knowledge of the principles of Mechanics and Mechanism is highly desirable to a satisfactory understanding of this subject. The time required is *two evenings per week* and the method of instruction is through lectures, recitations, problems, and the use of a text book.

622. Steam—1 Year.

It is the purpose of this course to study the various methods of heat generation, transmission, and utilization in use at the present day and to learn the theoretical relationship which underlie these processes and transformations.

The instruction covers, so far as time permits, the elements of steam engineering. The topics covered are heat and its measurement, use of steam tables, types of boilers, engines and turbines, boiler and engine room accessories, together with a study of the methods of testing the various types of apparatus. Actual tests on such equipment are made as the size of the class permits. Text books, laboratory and class work, and home problems are the methods of instruction used, requiring an attendance of *two evenings per week.*

623. Direct Current Electricity—2 Years.

This popular course is planned to cover the fundamentals of direct current circuits and machinery. The lectures on electrical theory are supplemented by laboratory work and the use of a text book and problems. It requires for its completion attendance for *two evenings per week* and a considerable amount of home study and preparation. Students who wish to take this subject must have studied one year of algebra.

The fundamental properties of electrical and magnetic circuits are studied both in the classroom and laboratory. Other topics include the measurement of resistance, the calculation and measurement of power in direct-current circuits, and the relation between the electrical, heat and mechanical units of energy. A large amount of laboratory and class work is given to make the student familiar with methods of operation, testing and control of direct current machinery.

624. Alternating Current Electricity.—2 Years.

This course is similar to Course 623 except that it deals with alternating current circuits and machinery. No student should plan to take this course unless he has previously taken at least one year of Course 623 or can show that he has had the equivalent.

The fundamental properties of alternating current circuits are first considered, and are followed by a study of the operation of alternating current machinery. The study of electrical measuring instruments is also included in this course. The instruction is given by means of lectures, recitations, and a large amount of laboratory work. An attendance of *two evenings per week* is required.

625. Power Plant Machinery—1 Year.

The purpose of this course is to teach the operating engineer how to test the various units usually found in a power plant. Numerical calculations are introduced and the interpretation of the results is of primary importance.

The following are some of the machines tested: engine, turbine, triplex pump, centrifugal pump, injector, etc. Various gages are also calibrated.

A test book is required and the class is held *two evenings per week.*

626. Mill Illumination—1 Year.

Because of the demand by mill men, this course is now offered to evening students and requires an attendance of *two evenings per week.*

Safety and production, factors entering into the design of lighting installations, industrial codes, costs and estimates are carefully considered. The laboratory exercises include the study of photometric curves of industrial units, study and use of the photometer, study of illumination by means of the Macbeth Illuminometer, and foot-candle meter.

The concluding work will be the complete design of a lighting installation, using the Institute laboratories or a local mill room.

Owing to limitations in apparatus, this course is open to a limited number of qualified men.

627. Textile Marketing—1 Year.

An elementary course designed to acquaint the student with the principles of selling and merchandising of textiles.

The selling agent, broker, converter, wholesaler, merchant, factor, and other

intermediaries in the channels of distribution are studied as well as the fundamentals of salesmanship, advertising, styling, market research, pricing, retailing, wholesaling, and forecasting.

The material is presented by means of lectures and class discussions on assigned problems. An attendance of *two evenings per week* is required.

Accounting Classes (Division of University Extension)

Classes in Elementary, Advanced and Cost Accounting have been offered in past years at the Lowell Evening Textile School under the auspices of the Division of University Extension, State House, Boston, Mass. Their continuance is dependent upon a sufficient expression of interest in them. Outlines of the courses, fees, etc., may be obtained by inquiry at the above address or by addressing the school.

FINISHING DEPARTMENT.

In these courses machine work is supplemented by lectures and discussions pertaining to the many finishes given to fabrics. The action of soaps, water, steam, heat and cold upon cloth containing one fiber or combination of fibers as used in commercial fabrics is carefully studied. These courses also help the finisher to broaden his knowledge of textile fabrics. Attendance is required for *two evenings per week.*

710. Woolen and Worsted Finishing—1 Year.

The outline of this course, which is given chiefly by means of lecture work, is as follows:

Burling and Mending.—Under this head are taken up for consideration the examination of flannel as it comes from the loom; the construction, use and location of the perch; the methods used in marking defects, measuring, weighing and numbering of cloths; also the methods of inspection for fancies, single cloths and double cloths. The object of burling, mending and the types of tables employed, the method of removing knots, runners, etc., the object of back shearing and the use of burling irons, the replacing of missing threads and the importance of sewing as a part of the finishing process, are also considered in detail. The removal of oil and tar spots as well as stains of various kinds is studied.

Fulling.—This branch covers a study of the conditions of the flannel as it comes from the loom, and the influence of oil, etc., upon the procedure. Considerable time is devoted to the various methods of producing a felt, the various types of stocks and their modifications and development into the present type of rotary fulling mills of both single and double variety. The details of construction in all machines are carefully taken up and include the design and composition of the main rolls, method of covering, regulation and means of adjusting the pressure of traps and rolls, and the use and regulation of the various types of stopmotion, the different types of stretchers, guide rolls and throat plates.

The theory of felt is taken up and the influence of pressure, moisture, heat, alkali and acid is considered, as well as the hydroscopic and felting properties of different wool fibers. The preparation of the flannel for the mill and the usual methods of determining shrinkages, as well as the various methods of soaping, are given careful attention. The preparation of various fulling soaps and the value of each for the production of various degrees of felt, as well as the determination of the proper amount of alkali for various goods, are carefully studied and demonstrated. The manipulation of the various kinds of goods in the mill, viz., all wool, reworked wools and mixed goods, is studied in classroom and by operation in the laboratory.

The change in weight and strength for each operation is carefully considered, as is also the value of the flocks made in each. A study of the various methods of flocking, such as dry and wet, is considered in both class and machine rooms. In each operation the defects likely to materialize are studied, as well as the cause thereof, and various methods of modifying or lessening them.

Washing and Speck Dyeing.—This branch considers the scouring, rinsing and washing of goods both before and after the fulling process; the various types of washers; and the details of construction, such as suds box, rolls, etc. The theory of scouring, uses of Fuller's earth, salt solutions and sours on the different kinds of goods are made clear by practical work in the machine room, where the effects due

to improper scouring, such as stains, cloudy effects, wrinkles and unclean goods, are demonstrated. The discussion of the necessity of speck dyeing follows naturally from the study of these matters, and includes methods of preparation, materials used, application and tests required.

Carbonizing.—This is an important branch of finishing, and includes a study of the various carbonizing agents, methods of application, strength of solutions and neutralizing, as well as the machines used. Stains and imperfections resulting from carbonizing are also considered. The drying and tentering machines and extractors employed are taken up at this point.

Gigging, Napping and Steaming.—The construction in detail of the various types of gigs, nappers, steamers, wet gigs, rolling, stretching, crabbing and singeing machines is discussed, and their actions upon the cloth and the results obtained are explained.

Various methods of obtaining luster and the production of permanent finish are considered in connection with steaming and sponging.

Brushing, Shearing and Pressing.—This includes, as do the other branches, a careful treatment of the machine employed, the preparation of the cloth for each process, the action of each machine in producing its part of the resultant effect. In the manipulation of the shear consideration is given to its setting, grinding and adjustment. With the brushing machine the effect of steaming and moisture upon the luster and feel of the goods is shown. A study of the action of the presses, both plate and rotary, involves consideration of pressure, steaming, etc. Special processes to obtain particular effects are taken up, and the part played by each machine is explained. The details involved in handling cloth on a commercial scale, as, for example, measuring, weighing, ticketing, numbering and rolling, are also explained. The necessary calculation and the methods of finishing all grades of goods are considered from time to time during the year.

Two evenings per week.

711. Cotton Finishing—1 Year.

The outline of the course in the finishing of cotton fabrics is as follows:—

Cloth Room.—Instruction of the various goods and the objects thereof; construction of the various types of inspecting and trimming machines.

Shearing.—The object. A consideration of the various types of shears for treating one or both sides at the same time; also the use of the usual cleaning devices, such as emery, sand and card rolls, beaters and brushes; grinding and the adjustment of the various parts.

The use of brushing and cleaning machines, rolling devices and calender attachments for gray goods.

Singeing.—Developing and object of singeing; the construction of singers of all types, and for various purposes; the use of cooling tanks, steaming devices, rolling and brushing attachments.

Regulation of the flame for various goods, and adjustment of the parts; gas and air pressure, water-cooled rolls; the effect of moisture on the cost of singeing; the use of dry cans in connection with singeing; electric singeing.

Washing.—Open width and string washers, their construction and operation; soaps, temperature, squeeze rolls; washing of various goods and the object thereof; stains.

Napping.—The object of napping and the usual method of treating goods; various types of nappers, single and double acting; felting nappers; construction, grinding and adjustment of various types.

Water Mangles.—Their object and construction of various types; various rolls,—iron, husk, etc., scutchers, their object and construction.

Starch Mangles.—The object and construction of all types of starch mangles for pure starch and filled goods; various types of rolls,—brass, rubber, wood; action of doctor blades, etc.; regulation and object of pressure.

Methods of starching and finishing all standard goods, also a consideration of the various substances used, such as starch, softener and fillers; the preparation of starch and various methods of application.

Dryers and Stretchers.—Both horizontal and vertical, tenter frames, clips; the swing motion and the finishes thus produced; construction; spraying machines, belt stretchers, button breakers; their object and construction.

Calenders.—The object and construction of all types, including the regulation of pressure and nips for the production of various finishes; various types of rolls and their uses,—steel, husk and paper; the use of hot and cold rolls; chasing, friction, embossing and Shriner calenders and the various finishes produced by each; production of watered effects; beetling machines.

Making up room,—yarding, inspecting; different types of folds; pressing, papering, marking.

Two evenings per week.

EVENING GRADUATES OF 1931.

Certificates awarded as follows, April 7, 1931:

Cotton Yarns—3 Years.

Peter Borrows, Jr.	Chelmsford
Wilfred Maynard Hutchinson	Methuen
Karl Frederick Gustav Maier, Jr.	Lowell

Worsted Manufacturing—4 Years.

William Taylor	Lawrence

Woolen Yarns—2 Years.

Hubert Joseph Beaumier	Lowell
Edgar Wallace Birdsall	Lowell
Donald Alison Buchan	North Andover
Frank Eugene Robitaille	Lowell

Cotton Design—3 Years.

Robert Norman Butterfield, Jr.	Watertown
Maurice Forman	Brighton
William Solloway	Manchester, N. H.

Woolen and Worsted Design—3 Years.

Laurie Stanford Baker	Methuen
Sherman Winthrop Boutwell	Andover
Otto Frank Minzner	Methuen
Eugene Paul Schremp	Lawrence
Thaddeus Walter Albert Stys	Lowell
Claude Alfred Taylor	Methuen
Theobald Eneas Trudeau	Nashua, N. H.
Minton Albro Winslow	Nashua, N. H.

Narrow Fabric Design—2 Years.

Sidney Wallace Greeley	Lowell
Daniel Claude Lynch	Lowell
Percy Lorenzo Willis	Lowell

Show Card Design—2 Years.

Leo Paul Champagne	Lowell
John Francis Dowling	Lowell
Joseph Calix Antonio Gagnon	Lowell
André Henri Gervais	Lowell

Freehand Drawing—3 Years.

Ruth Campbell	Lawrence
Anne Fay Cheney	Lowell
Gertrude Frances Roberts	Lowell

Cotton Weaving—1 Year.

Bernard Francis Brady	Lowell
Alfred Omer Chouinard	Lowell
George Henry Dumais	Lowell
John Janas	Lowell
Elmer Eino Mikkola	Lowell
George Robert Ray	Lowell
Walter Reginald Sorensen	Arlington
Albert Sugden	Lowell
Kazimiera Joanna Monarszynski Tarka	Lowell

Dobby and Jacquard Weaving—1 Year.

Bernard Francis Brady	Lowell

Woolen and Worsted Weaving—2 Years.

Melvin Frank Carter	Chelmsford
Granville Keith Cutler, Jr.	Andover
John Edward Cwiklik	Lowell
George Frederick Hemas	Lawrence
Frederick Marshall Rawnsley	Lowell

Cotton Finishing—1 Year.

Peter Borrows, Jr.	Chelmsford
George Robert Ray	Lowell

Woolen and Worsted Finishing—1 Year.

Donald Alison Buchan	North Andover
Clarence Albert Chaff	Lawrence
Arthur Edward Clift	Lawrence
Glendon Mandeville Elliott	Andover
Kendall True Greenwood	Andover
George Aloysius O'Brien	Methuen
George Sumner Orr	Methuen
Reginald Brooks Pawle	Lowell
John Joseph Slipkowsky	North Andover

Elementary Chemistry—2 Years.

William Henry Ahearn, Jr.	Lawrence
Alfred Raymond Bennert	Lawrence
William Henry Booth	Lawrence
Raymond Francis Delmore	Lowell
Charles Wilfred Gervais	Lowell
Thomas Joseph Hardiman	Haverhill
Donald Holden Kent	North Andover
Michael Herbert McHale	Lawrence
Douglas O'Brien Mahoney	Lawrence
Edward Herbert Ryan	Lowell
Joseph Usher Ryan, Jr.	Haverhill
Edgar Armand Seguin	Lowell
Ralph Woodbury Simmons	Lowell
George Abbott Snow, Jr.	Andover
Walter James Tumelty	Lowell
Herbert Charles Ware	North Andover
William Wilson	Manchester, N. H.

Textile Chemistry and Dyeing—3 Years.

Harry Goshgarian	Lowell
Norman Dane Hamel	Haverhill
Joseph Chanel Ricard	Lawrence

Analytical Chemistry—3 Years.

Edward Wilcox Clement	Nashua, N. H.

Textile and Analytical Chemistry—4 Years.

William Cameron	Methuen
Herbert Charles Haller	Lawrence
James Lester Lipsett	Methuen
Harold Norman Logan	Lowell
Frank James O'Neil	Lawrence

Mechanical Drawing—3 Years.

Lucien Oliver Arsenault	Lowell
Philip Clough Cook	Methuen
Joseph Thomas Dunnigan	Lowell
Albert Joseph Gauthier	Lowell
John Norris Hopkins	Dracut

Direct Current Electricity—2 Years.

John Henry Graham	Lowell
Howard Simpson Jones	Lowell
Eugene Charles Kohanek	Dracut
Richard Edward Picking	Lowell
James Allen Shanks	Dracut
Frank DeWitt Tallmadge	Lawrence

Mathematics—2 Years.

Howard Kenneth Bean	Lowell
John James Blessington	Lowell
Marion Grace Boissonneault	Lowell
Edmund Buckley	Lowell
Adolph Edward Cielakie	Lowell
Louise Elizabeth Cummings	Lowell
Leo Francis Eddy	Lowell
Walter Stephen Harrington	Lowell
Gertrude Pearl Henderson	Lowell
Clarence Wadsworth Hope	Lowell
Weldon Maxwell Huckins	Lowell
Thomas Paul Kelleher	Lowell
Boles William Kibildis	Lawrence
John Joseph Lavin	Lowell
John David Manning	Lowell
George Henry O'Neil	Lowell
Michael James Shyne	Lawrence

Machine Shop Practice—2 Years.

Walter Edward Kachinsky	Lowell
Francis Provencher	Lowell
Alfred Edward Savard	Lowell
Henry Andrew Strok	Lowell

Power Plant Machinery—1 Year.

Francis Wilber Anderson	Nashua, N. H.
David Sidney Birchall	Lowell
Roy Edward Blanchard	Graniteville
Lawrence Edward Caine	Methuen
William Henry Campbell	North Andover
Albert George Forty	Graniteville
Harry Sidney Forty	Graniteville
Michael William Schofield	Lawrence

Textile Marketing—1 Year.

Eugene Herbert Anderson	Lowell
John Andrew Calnin	Lowell
Edward Joseph Dunn	Lowell
Harold Charles Miner	Lowell
Richard Henry Ralph	Lowell
Robert Leatham Rawlinson	Lowell
Richard Edward West	Lowell

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Moody Street and Colonial Avenue

NOTE: This paper is the result of research and development work carried on in the laboratories of the Lowell Textile Institute by Bertil A. Ryberg, B.T.C., who is a graduate of the Institute. The work was made possible by an allocation of the Textile Foundation and the results were first published in the American Dyestuff Reporter from whom permission to reprint is given. It thus becomes a part of the records of research work done at the Institute. It is the result of more than a year's work on the part of one of the Research Associates of the American Association of Textile Chemists and Colorists working under the direction of its Research Committee.

For a long time it was the generally accepted opinion that no laboratory test could be devised that would equal in practical value or simplicity the mill practice of running such tests directly in the fulling mill. The accompanying paper describes a laboratory method, which is not only easily carried out but which has been pronounced more reliable and readily duplicable than any other laboratory or practical mill method.

PUBLICATION OF THIS DOCUMENT APPROVED BY THE COMMISSION ON ADMINISTRATION AND FINANCE
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THE FASTNESS TO FULLING OF DYED WOOL

By Bertil A. Ryberg, B.T.C., Research Associate of the American Association of Textile Chemists and Colorists

The original sub-committee on fastness tests for dyed wool, of the Research Committee of the American Association of Textile Chemists and Colorists, devised a laboratory method for determining the fastness of dyed wool to fulling, which, in their opinion, would give as satisfactory results as could be expected of any laboratory method. This method consisted of braiding a sample of the dyed yarn with white cotton, wool and silk, and soaking this braid in a slightly alkaline, dilute soap solution for sixteen hours at room temperature. It was then heated to 140 degrees F., milled briskly on a washboard until well felted, rinsed, dried and unraveled for examination.

This test compared fairly well with a two-hour mill fulling. The method is based upon the supposition that the action of the soap is much more important than any mechanical action. It gives only the one test equivalent to two hours of mill fulling. In actual practice, mill fulling is carried on anywhere from one-half to eight hours; therefore, this test does not begin to cover the requirements of an ideal laboratory test.

Until recently it was believed that it would be impossible to devise a laboratory method for determining fastness to fulling which would be as accurate or satisfactory as one conducted in an actual fulling mill under manufacturing conditions. The present Sub-Committee on fastness tests for dyed wool, namely, Hugh Christison, Chairman, Claxton Munro, Roland Derby, Alex. Morrison and Harold Leitch, were of the opinion that a laboratory fulling test might be devised, in which the mechanical action and other conditions obtained during the fulling process, could be more nearly duplicated.

With this in mind, the committee, during the past two years, largely with the assistance of two of the research associates, have conducted an extended research upon this subject, and the committee is pleased to announce that they believe that a test has been devised, which can be carried out in the laboratory, and is capable not only of giving results comparable with a test made in the actual fulling mill, but, in certain respects it is believed to be even more accurate and reliable.

The sub-committee believed that a laboratory method involving considerable mechanical action in the presence of soap, would more nearly approach actual mill fulling conditions, than does the older method. With these considerations in mind, the sub-committee suggested that the possibilities of using a sample felting machine (Am. Dyestuff Reptr., 1927, *16*, 683-685), which is in rather general use in the woolen and worsted mills, should be investigated.

The sample felting machine was tried out on cloth of different weights and grades of wool furnished by members of the sub-committee, who also furnished samples of these same materials after fulling, for comparison purposes. Soap concentrations were varied as were also the mechanical conditions of the machine. Elevated temperatures and various periods of time were tried, but the results were quite unsatisfactory and did not warrant further investigation in connection with cloth fulling.

The next step in the development of this laboratory method involved the use of the Launder-Ometer. The first tests were made as follows: Conveniently sized samples of an overcoating material were placed in glass jars, and small amounts of fulling soap were added together with several small steel balls. The samples were agitated for an hour. The felt produced was very poor. In order to produce more severe mechanical action, which would give a good felt, it was found necessary to use metal containers. Samples of an overcoating cloth were saturated with fulling soap at 120 degrees F., placed in brass containers together with ten ½ inch steel balls and agitated for one hour. A fair amount of felt was produced by this method. The same weight and varying weights of different sizes of balls were tried to see which would give the best results. The sizes used were ¼, ⅜, ½, and ¾ inch.

This method was not very satisfactory since the samples tended to stick to either the bottom or the top of the container. This method was also tried using felt pads instead of cloth. An attempt to use stock wool was tried by placing dyed carded wool in the bottom of the metal container, adding a small amount of fulling soap and twelve ¾ inch steel balls, but this did not work out very well.

In an attempt to overcome sticking of the samples, ¼ inch steel balls were sewn into the corners of the cloth samples, but that did not help any. Another attempt

to overcome sticking was made by using containers with a rounded bottom and top. It was thought that by not having any corners or prominent seams in the container the sample would have no place in which to stick. It was necessary to use an air bath for temperature control for these rounded containers. These containers did not seem to give any better results than the regular metal containers.

Samples of a colored overcoating containing white staining threads, were sewn up inside of small cotton bags together with twenty 3/8 inch steel balls. Fulling soap was added and the samples were agitated for one hour at 120 degrees F. The cotton bags broke through or were worn through, easily allowing the balls to escape.

The next step was to sew pieces of cloth into bags placing various numbers and sizes of steel balls inside. This gave a fulling action which produced a fair amount of shrinkage and felting. Pads made in the sample felting machine were sewn together and steel balls were placed inside as for the cloth. These were all agitated for an hour. It was concluded from observation that the severe mechanical action necessary to produce a good felt and which makes the use of metal containers necessary, was too severe for testing the fastness of the dyeings. In the course of this work, containers made of brass, of copper, of tinned copper, of galvanized iron, and of Monel Metal, were all tried out, to ascertain the difference in effect, if any, between the different metals.

It was thought that if a few of the larger steel balls, for example the 3/4 inch size, were used, the tendency to stick would be less and if only a few, say four, were used, would give less severe mechanical action. With less severe mechanical action, it would be safe to use the inexpensive glass jars, such as are used for the washing tests.

Felt pads appeared to be better than cloth for these tests. Two pads were sewn together forming a bag inside of which were placed four 3/4 inch steel balls and a small piece of union material. These bags were placed in jars, fulling soap was added and agitation begun. In tests of one hour or more the pads were either worn or broken through causing the jars to be broken.

The actual work and testing described in the preceding pages was done by William C. Smith, a research associate of the American Association of Textile Chemists and Colorists, in cooperation with the Sub-Committee on Fastness Tests for Dyed Wool.

The project was taken over at this time by Bertil A. Ryberg, a newly-appointed research associate. The work already done was reviewed and discussed at a meeting of the Sub-Committee members. In the course of the discussion several ideas were brought forward, three of the most promising were as follows:

1. The possibility of strengthening the felt pads, so that they would hold together in the Launder-Ometer, by incorporating the union material with the pads as they are being made in the felting machine. This also would take care of any staining which might occur while making the pads preliminary to the test.
2. Using one large steel ball in place of several smaller, thereby preventing any sticking and making it possible to use high titer soaps. This was tried out but gave very unsatisfactory results. Only the ends of the samples were felted and a worn shiny band was produced around the middle of the samples. It did prevent sticking, but that was its only advantage.
3. The possibility of using knitted material in place of woven material or felt pads.

Pads were made with the union material incorporated with them, and bags were made from these as previously described. Several series of tests were made with these bags, varying the temperature, soap type, amount and concentration, and the time interval. Several colors were tested under these variable conditions. This method appeared to be the best tried up to this time, but it was still unsatisfactory for several reasons, namely:

1. Both the sample felting machine and the Launder-Ometer are necessary for the test. They are expensive and very few mills can afford both.
2. The amount of time consumed in preparing the felt pads for the test is prohibitive.
3. The material to be tested must be stock, top or slub dyed.

The possibilities of adapting knitted material to testing in the Launder-Ometer were then investigated. Several sizes of knitted tubing were made, using yarns of various counts and twists. These tubes were scoured and dyed in the usual manner and then cut into suitable lengths. One end of each small length was sewn together, forming a bag, inside of which were placed a small piece, of the previously mentioned union material, and four 3/4 inch stainless steel balls, and

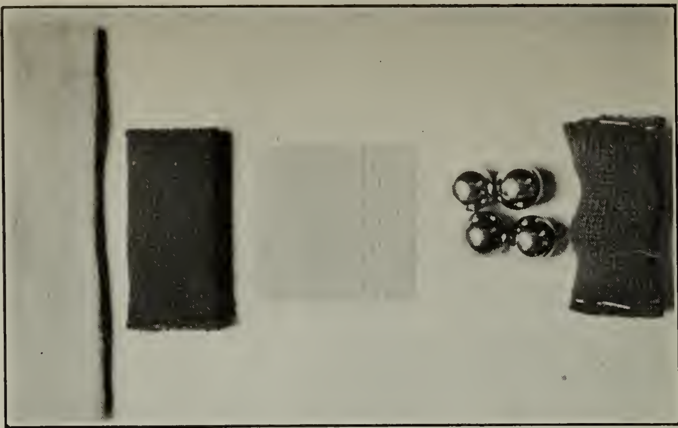

Fig. 1 — Reading from left to right, this figure shows a sample of the undyed knit tubing, a sample after dyeing, a sample of the union material, the four ¾" steel balls, and finally a sample ready to be tested.

After a series of such tests had been made, a knitted tube, one and five-eighths inches in width, made of one-quarter blood worsted yarn, size two-eighths (2/8s), with a low twist, was selected as giving the best results.

This method, making use of the knitted tubing, when compared to that wherein felt pads were used, was seen to be far superior in every way. The amount of time required to scour, dye, prepare and test samples in this way, is very much less than the other method. The idea of using tinned staples instead of sewing, in closing the ends of the test samples was tried. This worked very satisfactorily and also proved to be a considerable time saver. This is done by means of a Hotchkiss or other stapling machine such as is used for mounting samples. Shrinkage and felting, compared to mill fulling was produced. The very nature of a knitted fabric, in which the yarn is continuous, seems to be peculiarly adapted to the conditions of this laboratory method. It is more easily saturated with soap solutions, than is either the cloth or the felt pads, and it is also more easily rinsed, dried and mounted.

The knitted tubing as a vehicle for performing this laboratory test for fastness to fulling, was declared by the sub-committee to be the best so far devised. Now that a satisfactory vehicle for performing these tests was available, a series of such tests was begun in an effort to obtain a set of conditions which would give results more nearly comparable to the fulling mill, than already existed. These tests were carried out as follows:

1. Varying the temperature, holding the speed and soap concentrations constant.
2. Varying the speed of the Launder-Ometer, holding the temperature and soap concentration constant.
3. Varing the soap concentrations, holding the temperature and speed constant.
4. Varying the time interval under the above conditions.

The speed of the Launder-Ometer was varied by means of a gear reducer and a rheostat.

In order to have a standard of comparison, a series of samples prepared similarly as for the Launder-Ometer test, with the omission of the steel balls, was distributed to three different mills, there to be put through an actual mill fulling. They were to be given ½, 1, 1½, 2 hour periods of fulling. When these samples were returned, it was discovered upon examination, that the results were nowhere near alike. The samples from Mill No. 1 were badly stained but well felted and showed very little change in shade. Those from Mill No. 2 were very slightly stained and only felted a little and there was practically no change in shade. Those from Mill No. 3 were lightly stained with hardly any felt at all and the shade was materially altered.

The results of these mill tests clearly indicated the difficulty of choosing a standard set of conditions as well as standards for dye fastness. These mill tests clearly showed that a dyestuff or dyeing suitable for fulling in a certain mill for, say two hours, would probably only stand one hour of fulling, at the most, in another mill.

It was ascertained by inquiry that fulling mill practice and conditions vary almost as much as the number of mills doing fulling. Examples of these variations

same soap and the color fastness requirements are nowhere alike. In seven of the mills of the other company similar conditions exist. Under conditions such as these, the difficulty of selecting a set of standards, which would cover the requirements of all mills, is clearly seen.

A sample of the fulling soap used at Mill No. 2 was obtained. A set of samples were given the Launder-Ometer test using this soap, and on material which had had the same preliminary treatment as the samples of mill fulling which were furnished by this mill. The time intervals of the test were also the same. The results showed that the Launder-Ometer test was more severe in its action upon the color fastness itself, but it also produced more shrinkage and a thicker felt. In any case the Launder-Ometer method gives results at least equal to, if not slightly more drastic, than the most severe of the mill tests. A dyestuff or dyeing passing such a test satisfactorily, would be suitable for use in any mill, however severe the conditions of fulling might be. Also the method can be modified to cover the requirements of light mill fulling.

With the object in mind of having a laboratory test which would cover the most severe requirements, the sub-committee finally agreed upon the following set of conditions as being adequate:

"Specifications for a Laboratory Test for Fastness to Fulling of Dyed Wool"

Time .... ½, 1½, 4½ hours
Temperature of Test .... 90 Degrees F.
Type and Strength of Soap. U. S. P. Sodium Oleate
(5 ozs. Soap) per
(2 ozs. Soda Ash) Gal.
Amount of Soap..................... In proportion of 6 c.c. to a 3 gram Sample.
Speed of Launder-Ometer .... 42 R.P.M. (Normal Speed)

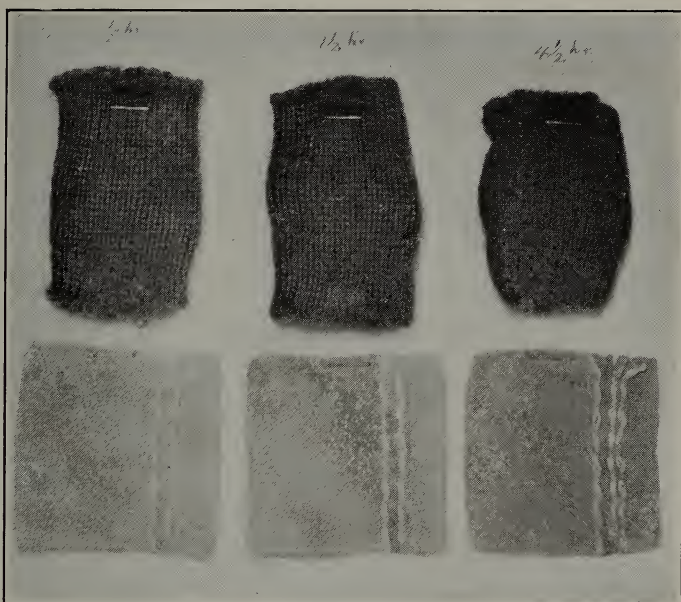

Fig. 2 — This figure shows a dyeing which has been given the standard test. Progressive shrinkage and felting is shown as well as progressive staining of the silk and wool in the union material.

"Standard Procedure for the Test"

Knitted tubing*, one and five-eighths inches wide, twelve cut or twenty-eight needle, made of two-eighths (2/8s) low twist worsted yarn, is scoured and then dyed with the dyestuff to be tested. It is then cut into suitable lengths, dependent

*The grey knitted tubing is obtainable from the Association through Louis A. Olney, Chairman of the Research Committee at the Lowell Textile Institute, Lowell, Mass., at a nominal cost, by those who are not in a position to purchase a knitting machine for themselves.

The union material is manufactured by the American Woolen Company at Andover, Mass., and may be obtained from them at a nominal price. It consists chiefly of a light weight worsted cloth into which have been woven the other four fibers in such a way as to form floats. The four fibers run warp ways

upon the amount of shrinkage desired, (three and one-quarter inches average), and one end of each piece is fastened together by means of a Hotchkiss or other stapling machine, or by sewing. A two and one-half inch square of union material containing five different fibers, namely silk, wool, viscose, cotton, and acetate rayon, and four three-quarter inch stainless steel balls are placed inside of the bag thus formed and the open end is then fastened or closed as before. The bags are placed each in a one pint glass jar, the fulling soap is added, the jars are sealed and placed in the Launder-Ometer. The Launder-Ometer at the temperature of the test, is started, run the length of time required, stopped and the jars are removed. The samples are rinsed in water at one hundred and ten degrees F., until the wash water is neutral to phenolphthalein, the balls are removed and the material is then dried in not less than one-half hour nor more than one hour.

These specifications were agreed upon after an examination of the results obtained in the course of the testing. Temperatures above ninety degrees F. were too severe in their action upon the fastness of the dyeings. Below ninety degrees is not feasible, being too hard to control. U.S.P. Sodium Oleate was specified to avoid any controversy over various commercial soaps. The composition of commercial soaps are apt to vary with the price of raw materials. U.S.P. Sodium Oleate is on the market at a reasonable price and is obtainable from the J. T. Baker Chem. Co. This being a low titer soap, it is very easy to work with and gives very even results. Some mills may wish to make their own sodium oleate from U.S.P. oleic acid, which is also on the market at a reasonable price. It is quite probable that mills using this method will use their own fulling soap, but since fulling soaps vary so in their composition and action, it was thought best to specify a soap of constant composition.

It was thought that by lowering the speed of the Launder-Ometer, results more nearly like the average fulling mill could be obtained. This was tried as before mentioned, but the increased cost of a rheostat and gear reducer, more than offset any advantage gained by the reduced speed. As it is, the method gives an accelerated test, which, if it gives satisfactory results, is what we are after.

Selection of Standards

Now that a reasonably satisfactory method had been agreed upon by the Sub-Committee, the problem of selecting fastness standards still remained. A group of dyes, forty-two in number, fairly representative of the different types of fastness requirements, were selected by the sub-committee, to be given the standard test already agreed upon. This standard test was performed upon the group of dyes so selected. The results of the tests were quite satisfactory. The dyestuffs selected seemed to behave as they were expected to, or were known to under manufacturing conditions. They seem to automatically fall into the different classes representing their relative degree of fastness. A few were on the border line between two classes, and from a previous practical knowledge of the dyes in question, this was expected to be so.

The standard tested samples of the above dyeings were submitted to the Sub-Committee for examination and discussion. In the course of the discussion several points were brought forward. The length of the tests seem to thoroughly cover the requirements for fastness. By actual test, it was proven that dyeings which would pass the four and one-half hour test satisfactorily, were of excellent fastness in mill practice. In the case of mills who only do light fulling, or whose fastness requirements are not at all severe, the one-half to one and one-half hour tests would cover their requirements nicely.

Under manufacturing conditions, the staining of silk is of much more importance than the staining of any other fibers. Therefore, it would seem most natural to select the staining of silk as a criteria for the staining of all fibers.

Standards could be selected in the following manner: A certain dyestuff or dyeing that did not stain silk at all, nor any of the other fibers, and does not lose any appreciable amount in shade in the four and one-half hour test, could be considered as say, Class 3. That would be one of excellent fastness. An example of such would be Erio Chrome Azurole BX or Alizarine Brown ZWS. Class 2 would be a dyeing which stained silk somewhat in the one and one-half hour test or more, but none of the other fibers. Examples of this class would be Meta Chrome Blue Black 2BX or Brilliant Milling Blue B. Class 1 would be a dyeing which stained silk somewhat in the one-half hour test and considerably in the longer tests. The wool would be slightly stained but not enough to make it unsuitable for light fulling. Anything staining more than class 1 would be considered unsuitable for

C. I.	Dyestuff	Method of Dyeing
. . .	2% Gallocyanine Blue	Dyed on Chrome Bottom
. . .	4% Meta Chrome Blue Black	Chrome in Dyebath
. . .	4% Alizarine Black WR	Bottom & Top Chromed
. . .	2% Brilliant Milling Blue B	Acid Dyed
714	3% Alphazurine A	Acid Dyed
712	3% Alphazurine 2G	Acid Dyed
208	2% Pontacyl Fast Blue R	Acid Dyed
169	3% Superchrome Violet B	Top Chromed
179	2% Azo Rubine R	Top Chromed
. . .	1% Pontacyl Sulphone Blue 5R	Top Chromed
931	2% Brilliant Aliz. Blue GA	Bottom Chromed
. . .	2% Anthracene Blue WR	Bottom Chromed
180	2% Chromotrope F4B	Top Chromed
. . .	3% Fast Mordant Blue B	Top Chromed
720	2% Erio Chrome Azurole	Top Chromed
1078	2% Aliz. Cyanine Green G extra	Top Chromed
1088	2% Aliz. Blue SKY	Top Chromed
1088	2% Aliz. Blue SKY	Acid Dyed
. . .	2% Acid Anthracene Brown PGA	Top Chromed
1085	2% Aliz. Blue Black B	Top Chromed
698	2% Wool Violet 4BN	Top Chromed
1075	2% Aliz. Astrole B	Top Chromed
. . .	2% Aliz. Brown B	Chrome in Dyebath
. . .	2% Aliz. Brown ZWS	Dyed on Chrome Bottom
289	3% Fast Wool Cyanone 3R	Chrome in Dyebath
1076	1% Acid Anthraquinone Blue RXO	Top Chromed
. . .	2% Aliz. Orange GR	Top Chromed
1034	2% Aliz. Red S	Top Chromed
1091	2% Aliz. Rubinole R	Top Chromed
. . .	2% Monochrome Brown BC	Top Chromed
652	2% Erio Chrome Red B	Top Chromed
203	4% Erio Chrome Black T	Top Chromed
201	6% Erio Chrome Blue Black BC	Top Chromed
. . .	2% Erio Chrome Brown R	Top Chromed
36	2% Aliz. Yellow GG	Top Chromed
. . .	2% Acid Chrome Red B	Top Chromed
. . .	2% Indocyanine B	Top Chromed
. . .	2% Xylene Milling Blue BL	Top Chromed
168	2% Superchrome Garnet Y	Top Chromed
216	2% Superchrome Red B	Top Chromed
344	2% Acid Anthracene Red 3B	Top Chromed
. . .	2% Kromeko Yellow CGW	Top Chromed

The fastness of dyeings in regard to the staining of wool could be classified on a similar plan, by comparing the staining of white wool by the dyeing being tested, with the staining of silk by the standard for that class. This same system could be applied to all fibers. In this way one set of standards would suffice for all purposes. It would establish a common ground between the dyestuff manufacturers and the mills. The degree of fastness of a dyestuff or dyeing to the staining of any fiber is easily classified. Each mill could classify the fastness of its dyeings to whatever fiber they are interested in. A dyeing could be classified in regard to its fastness to all fibers by a number. For example, Xylene Milling Blue BL could be classified by the following number: 02333, each digit standing for the fastness of the dyeing to one fiber only. The key to the number would be as follows:

0 — Zero fastness to silk, meaning that it is unsuitable for material containing silk.
2 — The fastness to wool is good being of class 2.
3 — The fastness to viscose rayon is class 3 which is excellent.
3 — The fastness to cotton is class 3 or excellent.
3 — The fastness to celanese is class 3 or excellent.

This particular color then would be suitable for a medium fulling on woolen material containing white wool, viscose, cotton and celanese, but would be entirely

Another dyeing might be numbered 13223 and rated as class 1 fastness to silk, class 3 or excellent fastness to wool, class 2 fastness to both cotton and viscose and class 3 fastness to celanese. Thus a dyestuff manufacturer can rate the fastness to fulling of his dyestuffs in regard to the staining of all fibers, by a number and this number would immediately signify to the mill man whether the dyestuff is suitable for his purpose or not.

A meeting of the Sub-Committee, attended by representatives of some of the larger dyestuff manufacturers, was held for the purpose of discussing this new laboratory method and to select standards to represent the various degrees of fastness. After considerable discussion, the method was accepted tentatively and the following dyeings were selected as standards to represent the various degrees of fastness to fulling of dyed wool.

2% Erio Chrome Azurole BX, C. I. 720.
3–4% Acetic Acid (28%).
20% Glauber's Salt Crystals.

Paste the dyestuff with the acetic acid and dissolve with hot water. Wool previously wet out hot, is entered into a 50 times bath at 120 degrees F. Raise to a boil in 20–25 mins. Boil 40 mins. Add 1.5% sodium bichromate and continue boiling for 45 mins. Rinse, extract and dry.

2% Brilliant Milling Blue B.
5% Acetic Acid (28%).
20% Glauber's Salt Crystals.

Wool previous wet out hot, is entered into a 50 times bath at 120 degrees F. Raise to a boil in 15 mins., boil 45 mins. Add 1% sulphuric acid (conc.) and boil for 30 mins. Rinse, extract and dry. When sulphuric acid is used in dyeing, rinsing should be thorough, to eliminate the effect of free acid on the fulling soap and alkali.

1% Alizarine Blue SKY, C. I. 1088.
5% Acetic Acid (28%).
20% Glauber's Salt Crystals.

Wool previously wet out hot, is entered into a 50 times bath at 120 degrees F. Raise to a boil in 15 mins. and boil 45 mins. Add 1% Sulphuric Acid (conc.) and boil 30 mins.

The above dyeings represent three distinct classes or degrees of fastness, the Erio Chrome Azurole being the best, the Brilliant Milling Blue B good, and the Alizarine Blue SKY being only fair. In selecting these standards, silk was made the criteria for staining. The staining of other fibers will be compared with the staining of silk by the standards and rated accordingly. As is to be expected, the loss in depth of shade seems to hold fairly well for the different standards.

Now that this new laboratory method had been accepted tentatively and the standards selected, the next step was to have several different laboratories perform this test according to specifications, on material furnished by the research associate, in order to check the practicability of the test and method. The following laboratories kindly performed the test as specified:

American Woolen Co.	National Aniline and Chemical Co.
Pacific Mills.	General Dyestuffs Corp.
Lowell Textile Institute.	E. I. du Pont de Nemours & Co.

The results obtained by the above cooperators were very gratifying. The samples returned checked each other very closely. This duplication of results by different laboratories clearly indicates that the method is consistent in its results and therefore is a practical and reliable test.

Favorable comment has been received from all of the cooperating laboratories, regarding the test and method. The material is well felted, approaching that of the actual fulling mill. The staining is even and easily distinguished on the union material. Tested samples can easily and neatly be mounted for filling purposes.

This method and standards have been adopted as final by the Sub-Committee on Fastness Tests for Dyed Wool, and will be presented at the annual meeting for final adoption and incorporation into the Year Book, by the Research Committee of the American Association of Textile Chemists and Colorists.

ACKNOWLEDGMENT

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Southwick Hall

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Moody Street and Colonial Avenue

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CALENDAR

1932–1933

September 8–9, Thursday–Friday	Entrance Examinations
September 12–17, Monday–Saturday	Re-examinations
September 15, Thursday, 9.00 A.M.	Registration for Freshmen
September 19, Monday	Registration for upper-class students Classes begin for Freshmen
September 20, Tuesday	Classes begin for upper-class students
October 12, Wednesday	Columbus Day — Holiday
November 11, Friday	Armistice Day — Holiday
November 22, Tuesday, 4.45 P.M.	Thanksgiving recess begins
November 28, Monday, 9.00 A.M.	Thanksgiving recess ends
December 20, Tuesday, 4.45 P.M.	Christmas recess begins
January 4, Wednesday, 9.00 A.M.	Christmas recess ends
January 16, Monday	First term examinations begin
January 27, Friday	End of first term
January 30, Monday	Second term begins
February 22, Wednesday	Washington's Birthday — Holiday
March 24, Friday, 4.45 P.M.	Spring recess begins
April 3, Monday, 9.00 A.M.	Spring recess ends
April 19, Wednesday	Patriots' Day — Holiday
May 22, Monday	Second term examinations begin
May 30, Tuesday	Memorial Day — Holiday
June 6, Tuesday	Commencement
June 8–9, Thursday–Friday	Entrance Examinations

1933–1934

September 14–15, Thursday–Friday	Entrance Examinations
September 18–23, Monday–Saturday	Re-examinations
September 21, Thursday, 9.00 A.M.	Registration for Freshmen
September 25, Monday	Registration for upper-class students Classes begin for Freshmen
September 26, Tuesday	Classes begin for upper-class students
October 12, Thursday	Columbus Day — Holiday
November 28, Tuesday, 4.45 P.M.	Thanksgiving recess begins
December 4, Monday, 9.00 A.M.	Thanksgiving recess ends
December 22, Friday, 4.45 P.M.	Christmas recess begins
January 3, Wednesday, 9.00 A.M.	Christmas recess ends
January 15, Monday	First term examinations begin
January 26, Friday	End of first term
January 29, Monday	Second term begins
February 22, Thursday	Washington's Birthday — Holiday
March 23, Friday, 4.45 P.M.	Spring recess begins
April 2, Monday, 9.00 A.M.	Spring recess ends
April 19, Thursday	Patriots' Day — Holiday
May 21, Monday	Second term examinations begin
May 30, Wednesday	Memorial Day — Holiday
June 5, Tuesday	Commencement
June 7–8, Thursday–Friday	Entrance Examinations

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Assistant Professor of Textile Design

John Charles Lowe . . . . 161 Dracut Street
Assistant Professor of Textiles

Martin John Hoellrich . . . . 30 Saxonia Avenue, Lawrence
Assistant Professor of Weaving

Elmer Edward Fickett, B.S. . . . . 162 Hovey Street
Assistant Professor of Analytical Chemistry

Frederick Steere Beattie, Ph.B. . . . . 285 Foster Street
Assistant Professor of Organic Chemistry

Harold Canning Chapin, Ph.D. . . . . 290 Pine Street
Assistant Professor of General Chemistry

Charles Lincoln Howarth, B.T.C. . . . . North Billerica
Assistant Protessor of Dyeing

Percy Charles Judd, B.S. . . . . 156 Methuen Street
Assistant Professor of Electrical Engineering

Harry Chamberlain Brown, S.B. . . . . 272 Merrimack Street
Assistant Professor of Physics and Mathematics

James Guthrie Dow, A.B. . . . . 11 Robbins Street
Assistant Professor of English

Cornelius Leonard Glen . . . . R. F. D. No. 1, Tewksbury
Assistant Professor of Finishing

A. Edwin Wells, B.T.E. . . . . . . .204 Franklin Street, Melrose Highlands
Assistant Professor of Mechanical Engineering

Russell Lee Brown, B.T.E. . . . . 59 Bradstreet Avenue
Assistant Professor of Textiles

Charles Harrison Jack . . . . R. F. D. No. 1, Pelham, N. H.
Instructor in Machine Shop Practice

Albert Greaves Sugden . . . . 673 School Street
Instructor in Weaving

Arthur Joseph Woodbury . . . . 41 Morey Street
Instructor in Cotton Yarns

Russell Metcalf Fox . . . . 359 Beacon Street
Instructor in Textile Design

Charles Arthur Everett, B.T.C. . . . . Chelmsford
Instructor in Dyeing

James Harrington Kennedy, Jr. . . . . 177 A Street
Instructor in Wool Yarns and Sorting

William George Chace, Ph.B. . . . . 7 Sanborn Street
Instructor in Chemistry

John Leslie Merrill, B.T.E. . . . . 2026 Middlesex Street
Instructor in Weaving

John Henry Skinkle, S.B. . . . . 7 Sanborn Street
Instructor in Chemistry

Franz Evron Baker, B.T.E. . . . . 153 Sayles Street
Instructor in Cotton Yarns

Charles Frederick Edlund, B.S. . . . . 272 Merrimack Street
Instructor in Sales Engineering

Milton Hindle, B.T.E. . . . . . . 24 Highland Avenue, Melrose Highlands
Instructor in Mechanical Drawing

Horton Brown, B.S. . . . . 47 Pond Street, Marblehead
Instructor in Mathematics

Elmer Percy Trevors . . . . 18 Rhodora Street
Assistant Instructor in Chemistry

Paul David Petterson . . . . East Chelmsford
Assistant Instructor in Machine Shop Practice

Joseph James Pizzuto, Jr. . . . . 65 Sterling Street
Assistant Instructor in Chemistry

Robert Campbell Wilkie . . . . 298 Pawtucket Street
Assistant Instructor in Woolen Yarns

George Forsythe . . . . 199 North Main Street, Andover
Assistant Instructor in Cotton Yarns

Raymond Lewis Matthews . . . . 298 Pawtucket Street
Assistant Instructor in Chemistry

Simon Shapiro . . . . 84 Cambridge Street
Assistant Instructor in Mechanical Drawing

Walter Ballard Holt . . . . 37 Albert Street
Bursar

Ruth Foote, A.B., S.B. . . . . 46 Victoria Street
Registrar

Florence Moore Lancey . . . . 46 Victoria Street
Librarian

Helen Gray Flack, S.B. . . . . 445 Stevens Street
Secretary

Mona Blanche Palmer . . . . 685 Westford Street
Clerk

Ardean Kent Lance, S.B. . . . . 173 Nesmith Street
Clerk

HISTORICAL SKETCH
of the
LOWELL TEXTILE INSTITUTE

By virtue of legislative acts of 1928, the Lowell Textile School became known as the Lowell Textile Institute in order to more clearly define the standing of the institution. This was the natural result of the development of the original ideas and policies of the trustees who founded the Lowell Textile School. The articles of incorporation were authorized by Chapter 475, Acts of 1895, and provided for a corporation to be known as the Trustees of the Lowell Textile School of Lowell, Massachusetts. The movement for the establishment of the school dates from June 1, 1891, but it was not opened for instruction until February 1, 1897.

In accordance with the acts of incorporation the Board of Trustees consisted of twenty permanent and self-perpetuating members, three-fourths of whom must be "actively engaged in, or connected with, textile or kindred manufactures." In addition, his Honor the Lieutenant-Governor, the Commissioner of Education of the State, the mayor, the president of the municipal council, the superintendent of schools of Lowell, and a representative of the textile council were members *ex-officio*. Legislative acts of 1905 and 1906 authorized the graduates of the school to elect four trustees serving for periods of four years each.

By virtue of the anti-aid amendment to the State Constitution, and by Chapter 274, General Acts of 1918, the property of the school was transferred on July 1, 1918, to the Commonwealth of Massachusetts, and the control and management of the school was vested in a Board of Trustees appointed by the Governor, "with all the powers, rights and privileges and subject to all the duties" of the original Board.

In locating the Institute at Lowell, which has been called the "Mother Textile City of America," considerable advantage is secured by close association with every branch of the industry, which utilizes almost every commercial fiber in the products of the great Merrimack Valley textile district.

Although the school was formally opened by Governor Roger Wolcott on January 30, 1897, in rented quarters in the heart of the city, it was not until January, 1903, that the first buildings of the present plant were ready for occupancy. On February 12, 1903, Governor John L. Bates dedicated the present buildings.

PURPOSE AND SCOPE OF THE INSTITUTE

The object of the establishment of the Institute as set forth in the original act was "for the purpose of instruction in the theory and practical art of textile and kindred branches of industry."

The plan was occasioned by the apparent crisis in the leading industry of New England, due to the rapid development of the manufacture of the coarser cotton fabrics in the southern States. It was believed that this crisis could be met only by a wider and more thorough application of the sciences and arts in the production of finer and more varied fabrics.

Following the general methods and systems found successful at the higher polytechnic institutes, it offers thorough instruction in the principles of the sciences and arts applicable to textile and kindred branches of industry. The courses treat not only of the theory but also the application of these principles in the processes, on the machines and throughout all departments of industry involved in the successful manufacture, application and distribution of textile material in any form.

Though from the first the management has kept in view the clearly defined objective which called for the establishment of the Institute, it has developed its curriculum, its methods of instruction, and equipment as the needs of the industry arose. This objective will be kept constantly in view, and as new demands are presented an effort will be made to extend courses, equipment and floor space. The mechanical equipment of the Institute includes the best makes of textile machinery, and these machines, while built as they would be for regular work, are, as far as possible, adapted to the experimental work which is of particular value in such an institution as this.

Because of the breadth, grade and character of instruction given, and because of the standing and personnel of the instructing staff, the Institute has been placed by both Federal and State educational boards in the class of the higher technological schools of this country.

The United States Civil Service Commission recognizes graduates from the degree courses of this school as proper applicants for the examination to the various positions requiring a knowledge of applied science and engineering, as well as a knowledge of textile manufacturing, in the different departments of the government.

The day classes have been organized for those who can devote their entire time for three or more years to the instruction requisite in preparing to enter the textile industries. It has been found necessary to require of all such students educational qualifications equivalent to those given by a regular four-year course of a high school or academy of good standing.

The evening classes are held for about twenty weeks of the year, and are for those who are unable to attend the day courses. These are similar to the day courses, but are aimed especially to meet the needs of students working during the day in the mills and shops. For entrance to these classes an applicant should have the equivalent of a grammar school education. A detailed description of these courses and requirements is given in another Bulletin, which will be sent upon request.

BUILDINGS AND GROUNDS

The site is a commanding one, consisting of about 15 acres at a high elevation on the west bank of the Merrimack River. It extends to and overlooks the rapids of Pawtucket Falls, which was the first water power in America to be used on an extensive scale to operate power looms. It was contributed by Frederick Fanning Ayer, Esq., of New York City, and the Proprietors of the Locks and Canals on the Merrimack River.

Southwick Hall, the main building, fronting on Moody Street, was contributed by the Commonwealth of Massachusetts and Frederick Fanning Ayer, Esq., and is a memorial to Royal Southwick, a leading textile manufacturer, a public man of earlier days, and a maternal ancestor of Mr. Ayer. It includes a central mass 90 by 90 feet, having three stories and two wings 80 by 85 feet each with two stories and well-lighted basements. The building is pierced in the center by an arched way from which access is had to the wings and to the central courtyard. The northern wing is occupied by the General Offices, Engineering and Finishing Departments, and Library, while the southern wing is entirely occupied by the Chemistry and Dyeing Departments.

Kitson Hall, dedicated to the memory of Richard Kitson, was contributed by Charlotte P. Kitson and Emma K. Stott, his daughters; the Kitson Machine Company of Lowell, founded by Mr. Kitson, was also a generous contributor. This hall makes a right angle with Southwick Hall, is 70 by 183 feet, has two stories and a basement and houses the Cotton Yarn and Knitting Departments, the Mechanical and Electrical Engineering laboratories and the Machine Shop.

The Falmouth Street Building forms the third side of the quadrangle, and consists of three portions, one 60 by 75 feet, three stories, one 75 by 130 feet, three stories, and the head house 70 by 80 feet, three stories and basement. The building is occupied by the picker section of the Cotton Yarn Department, the Design and Power Weaving Department and by the Woolen and Worsted Yarn Department, and contains on the lower floors an equipment for the manufacture of wool yarn from the fleece to the finished yarn. The upper floors are occupied by a great variety of plain, dobby and Jacquard looms, and in a section of the building are the students' lockers and recreation rooms.

Colonial Avenue Building was erected in the summer of 1910 from plans prepared by the Engineering Department, which also had in charge the work of construction. The building completes the fourth side of the quadrangle, and in outward appearance corresponds to the architectural features of the other school buildings. It is a single-story building, and has the dimensions of 195 by 60 feet. Its interior is faced with cement brick made at the school during the progress of the

work. These serve to give light-reflecting walls which are advantageous for the work of the Wool Manufacturing, Cotton Finishing and Chemistry and Dyeing Departments that occupy this building. The funds for this building were provided by the State of Massachusetts.

The buildings are of modern mill construction adapted to educational uses and contain approximately 180,563 square feet.

CAMPUS

Through the generosity of Mr. Frederick Fanning Ayer the Institute has been provided with a campus and athletic field of about 3 acres. This has been carefully graded and laid out for baseball, football and track athletics.

To enclose this field the Alumni Class Fence has been partly built. It is made of forged iron sections supported between brick columns. Each section is contributed by a class, so that in the course of a few years this fence will entirely enclose the field.

On the upper floor of the Falmouth Street Building there has been provided a recreation room for the use of the students at such times as their attendance is not required in classes.

In the basement of this building there are rooms for the use of the athletic teams. Connected to these are showers and dressing rooms.

The upper hall of Southwick Hall has been equipped with gymnastic apparatus. Chest weights, wooden dumb-bells, Indian clubs, a set of traveling rings, a vaulting horse, parallel bars, a punching bag and several sets of foils and single sticks have been provided.

In order to be sure that no student having any dangerous physical weakness takes part in any athletic contest, all candidates for the various athletic teams are obliged to pass a satisfactory physical examination.

ENTRANCE REQUIREMENTS

Particular stress should be laid upon a thorough grounding in mathematics, including algebra, arithmetic and plane geometry, as these form the basis upon which the work of this school rests. While solid geometry is not required at the present time, the student will find a knowledge of this subject very valuable in his subsequent work, and is strongly recommended to include this subject as one of his electives. A preliminary course in science, including physics and chemistry, serves to prepare the student's mind for the higher branches of these subjects and their application, but neither will be considered as the equivalent of the courses in these branches given in the Institute.

Degree Courses

Candidates for admission to either of the degree courses must be graduates of a school approved by the New England College Entrance Certificate Bcard or by the board of Regents of New York, and must present a certificate from the principal of the school last attended, reporting upon the subjects pursued and the points obtained according to the schedule of studies given hereafter. A total of fifteen points is required.

A point represents satisfactory work in a year's study in a specified subject in an approved secondary school.

Required Subjects

Algebra A1	1
Algebra A2	1
English	4
Elementary French A (two years) or Elementary German A (two years)	2
Plane Geometry	1
History (American, Medieval and Modern, or English)	1
Physics	1
	11

Elective Subjects

	Points
Chemistry	1
Elementary French (two years) or Elementary German (two years)	2
Advanced French or German (one year in addition to requirements of Elementary French A or Elementary German A)	1
History:	
American	1
Medieval and Modern	1
English	1
Latin	1
Mechanical Drawing	1
Mechanic Arts	1
Solid Geometry	1
Spanish	1
Trigonometry	1

An applicant may also be admitted on the basis of entrance examinations, in which case he must pass a sufficient number of the required subjects to make ten points and present certificates showing satisfactory courses in such of the elective subjects to make three additional points.

The objective of the elective requirements is to encourage greater breadth of preparation than that covered by the required branches. Certificates covering other subjects than those listed as elective will be entertained.

Diploma Courses

Candidates for admission to the diploma courses are accepted upon presentation of properly vouched certificates showing the completion of a regular four-year course in a high school or academy of reputable standing. The certificate must specify that the applicant has satisfactorily passed the required subjects.

A total of twelve points is required.

Required Subjects	Points
Algebra A1	1
Algebra A2	1
English	4
Plane Geometry	1
History (American, Medieval and Modern, or English)	1
Physics	1
	9

Elective Subjects

Three may be selected from the list under Degree Courses.

ENTRANCE EXAMINATIONS

All students who are unable to present a certificate for either the degree or the diploma courses must pass entrance examinations. Notification of intention to take these examinations must be made in writing at least a week before the date of the examinations. These will be held as follows:—

Thursday, June 8, 1933; Thursday, September 14, 1933; Thursday, June 7, 1934:—
- Algebra, 9 A.M. to 11 A.M.
- History, 11 A.M. to 1 P.M.
- English, 2 P.M. to 4 P.M.

Friday, June 9, 1933; Friday, September 15, 1933; Friday, June 8, 1934:—
- Plane Geometry, 9 A.M. to 11 A.M.
- German or French, 11 A.M. to 1 P.M.
- Physics, 2 P.M. to 4 P.M.

Candidates failing to pass the June examinations are allowed to try again in September; those who cannot attend the June examinations may present themselves in September.

REQUIRED SUBJECTS FOR ENTRANCE

Algebra A1.—Derivation and use of simple formulas, graphical representation, the meaning and use of negative numbers, linear equations, with one or two unknown quantities, ratio and proportion, the essentials of algebraic technique, simple cases of exponents and radicals.

Algebra A2.—Numerical and literal quadratic equations in one unknown quantity, the binomial theorem for positive integral exponents, arithmetic and geometric series, simultaneous linear equations in three unknown quantities, simultaneous equations consisting of one quadratic and including graphical solutions, exponents and radicals.

Plane Geometry.—The usual theorems and constructions of good textbooks, including the general properties of plane rectilinear figures, the circle and the measurement of angles, similar polygons, areas, regular polygons, and the measurement of the circle. The solution of original problems and problems in mensuration of lines and plane surfaces.

English.—As secondary schools are following to a greater extent than heretofore the requirements of the College Entrance Examination Board, it is recommended that the applicant to this school conform to the suggestions of this Board relative to English composition and literature.

The examination consists of two parts, both of which are given at the same time.

(*a*) With the object of testing the student's ability to express his thoughts in writing clearly and correctly he will be required to write upon subjects familiar to him. Emphasis will be laid upon the composition, punctuation, grammar, idiom and formation of paragraphs. He will be judged by how well he writes rather than by how much he writes.

(*b*) The second part of the examination is prepared with the view of ascertaining the extent of the student's knowledge of good literature, and to test this examination questions will be based on the books adopted by the National Conference on Uniform Entrance Requirements. Any course of equivalent amount if made up of standard works will be accepted.

History.—Applicants may offer a preparation of American history, English history, or medieval and modern history.

In American history applicants should be familiar with the early settlements in America, the colonies, their government, the customs of the people, and events which led to the establishment of the United States. They should be informed concerning the causes and effects of the principal wars in which the country has been involved. They should be prepared to consider also questions requiring an elementary knowledge of civil government, as well as historical facts connected with the growth of this country up to the present time.

For the subject of English history or medieval and modern history the course given in any reputable secondary school should give proper preparation. A course extending over a full year with not less than three periods a week will be accepted.

Physics.—The applicant should be familiar with the fundamental principles of physics, particularly those considered under the headings of mechanics, heat, light, electricity and magnetism. Textbook instruction should be supplemented by lecture table experiments. Wherever possible, the student should pursue a laboratory course, but for the present no applicant will be conditioned in this subject if he has not been able to carry on a laboratory course. Where a laboratory course is offered by a secondary school, it should cover at least twenty-five of those experiments listed in the syllabus of the College Entrance Examination Board.

Modern Languages.—Required for degree courses only. It is expected that the work in these subjects has covered a period of at least two years of preparatory school training or the equivalent. Importance should be given to the ability to translate into good idiomatic English, but attention should also be paid to grammar and construction, that greater care may be used in translation.

Elementary German A.—The entrance examination is composed of two parts, both taken, however, at the same time.

(*a*) Translation of simple German prose into good idiomatic English.

(*b*) Questions to test proficiency in grammar, and simple English sentences to be rendered into German.

The requirements include the declension of articles, adjectives, pronouns and nouns; the conjugation and inflection of weak and strong verbs; the simpler uses of the subjunctive; the use of the modal auxiliaries; the prepositions and their uses; the principal parts of important verbs; and the elementary rules of syntax and word order.

Texts used in the language courses of any reputable high or preparatory school will furnish reading for translation. A list of texts is offered by the College Entrance Examination Board.

Elementary French A.—The entrance examination is composed of two parts, both taken, however, at the same time.

(*a*) Translation of simple French prose into good idiomatic English.

(*b*) Questions to test proficiency in grammar, and simple English sentences to be rendered into French.

The requirements include the principal parts, conjugation and inflection of the regular and the more common irregular verbs; the singular and plural forms of nouns and adjectives; the uses of articles and partitive construction; the forms and positions of personal pronouns; and the simpler uses of the conditional and subjunctive.

Suitable texts are suggested by the language courses of any reputable high or preparatory school and by the requirements of the College Entrance Examination Board.

Students who have pursued two years of elementary French as well as two years of elementary German may present one subject to cover two points in the required subjects, and the other to cover two points in the elective subjects.

ELECTIVE SUBJECTS

History.—If the applicant can present all three or any two branches of history specified he may include one as a required subject and the others in the list of elective subjects.

Chemistry.—Applicants must show evidence of their familiarity with the rudiments of chemistry. Any course given in a secondary school organized to present instruction by means of textbook or lecture, together with correlated laboratory work, will be considered as covering the requirements. The applicant's notebook with his original notes, including description of experiment, apparatus used, reactions, observations and deductions, must be accompanied by his instructor's certificate.

Importance will be placed upon manipulation and deductions as well as the general appearance and neatness of the notebook.

Solid Geometry.—The usual theorems and constructions of good textbooks, including the relations of planes and lines in space, the properties and measurement of prisms, pyramids, cylinders and cones; the sphere and spherical triangles. The solution of original problems and the applications of the mensuration of surfaces and solids.

Trigonometry.—The usual courses of instruction covered by the standard textbooks on plane and spherical trigonometry will prepare an applicant sufficiently to meet this requirement.

Mechanical Drawing.—The applicant must have pursued such a course in mechanical drawing that he will be familiar with the usual geometrical construction problems, projection of points, lines, planes and simple solids.

Importance is laid not only upon the accuracy with which the work is performed, but upon the general arrangement, appearance and care with which the plates are executed.

It should not be understood that work in this subject may be offered as the equivalent of the first term's work at the Institute.

Mechanics Arts.—The usual courses offered by properly equipped preparatory schools will be accepted as suitable fulfilment of this requirement. Work should include instruction in the handling of both wood and metal working tools in the more simple practices of these arts.

Elementary French B.—Applicants who enter for one of the three-year courses may present one year's work in French in a secondary school. Those who present themselves for examination in this subject should be familiar with the rudiments of grammar, and be able to translate simple French prose into good idiomatic English, also to translate into French English sentences, based on the French given for translation.

Elementary German B.—Applicants who enter for one of the three-year courses may present one year's work in German in a secondary school. What is stated in regard to French applies to those who may present German instead of French.

Advanced French or German.—In cases where applicants have pursued courses in French or German for more than two years, and have completed work which is more advanced than is included under elementary French or German, they may offer the additional year as an elective.

Spanish.—Students offering Spanish should be familiar with elementary grammar, the common irregular verbs, and be able to translate simple Spanish to English or English to Spanish. A preparation equivalent to three periods per week for two years will be acceptable.

Latin.—Students who have pursued one or more years of Latin may present this subject as an elective. Each year's work satisfactorily completed will be considered equal to one point.

ADVANCED STANDING

Candidates who may have received previous training in any of the subjects scheduled in the regular course will, upon presentation of acceptable certificates, be given credit for such work.

GRADUATE COURSES

Graduates of technical courses of other schools are invited to communicate with the president with reference to special courses in the textile studies. Previous training in the sciences and the engineering branches will usually reduce materially the time necessary to complete any of the courses at the Institute. The advantages offered to such persons for special research work are unexcelled, and a most profitable course may be arranged.

COURSES OF INSTRUCTION

Degree Courses.—The four-year degree courses are as follows:

Textile Engineering.

Chemistry and Textile Coloring.

At the completion of these courses the degrees of Bachelor of Textile Engineering (B.T.E.) and Bachelor of Textile Chemistry (B.T.C.) are conferred.

Five options are offered in the Engineering Course, viz., general textile, cotton manufacturing, wool manufacturing, design, or sales option. Each of these courses is planned to train one in the fundamental principles of science found to be applicable in the particular fields of textile chemistry and textile engineering. It is maintained that for one to be successful in either of these important branches of industry a training is required as thorough and broad as that of any of the recognized branches of engineering or of applied science.

With this in mind these courses have been built of a secure framework of science and mathematics, and to it has been added the useful application of these branches in the broad textile field. With the direct purpose of laying a secure foundation in the training, a more extended preparatory course is first demanded, and subsequently in the school work more subjects of a general character are included, that narrowness of judgment and observation may not result by overstimulation of the technical development.

Diploma Courses.—The following courses extend over a period of three years and upon the completion of any one of these the diploma of the Institute is awarded:

Cotton Manufacture.

Wool Manufacture.

Textile Design.

These are the original courses offered at the Institute, arranged to require three years' study and to give the student as thorough a training as possible for his chosen field, stressing particularly the study of textiles.

COURSES FOR WOMEN

Although all classes are open to women, the courses which have appealed especially to their tastes have been textile designing and decorative art. Some have pursued courses in chemistry, and have added to their work in design some instruction in power weaving and finishing. These special courses have in general been followed for three years and in some cases have led the students to positions either in the mill office or in some commercial lines that have been desirable and have offered congenial work.

Within the last few years the possibilities for women in certain branches of textile chemistry have become recognized and it is believed that in the future the positions open to them will become more and more numerous.

GENERAL INFORMATION

Application for Admission.—A blank form of application for admission may be found at the end of this bulletin. This should be properly filled out by all applicants, whether entering upon certificate from a secondary school or presenting themselves for examination.

Freshman Registration.—Each freshman is expected to be in daily attendance beginning Thursday, September 21, at 9.00 A.M., and to follow the prepared program which will be placed in his hands. A program which is planned to acquaint the new student with the institution, its location and surroundings, its courses of instruction, its recreational activities and other phases of its life is arranged for

the opening week. Unless arrangements for room and board are made previously, the first two days of the week may be used for this purpose. Physical examinations as well as certain other tests are given during this orientation period. Freshman week enables the student to secure the advantages which come from acquaintance with his surroundings, his instructors, the members of his class, student organizations, activities and customs. The overcrowding of the first week of classes with distractions is thus avoided.

Registration.—All upper classmen are required to register on or before the Monday of the week beginning the school year, and all students during the midyear examination period. For unexcused delay in registration a fee of $5 will be imposed.

Sessions.—The regular school sessions are in general from 9.00 A.M. to 12.50 P.M., and from 1.55 to 4.45 P.M., except Saturdays, when no classes are held. On Saturday afternoons the buildings are closed.

An hour plan designates the hours at which the various classes meet. This is rigidly adhered to, and the student is marked for his attendance and work as therein scheduled.

Attendance.—Attendance is required of all students on fourteen-fifteenths of all scheduled class exercises, provided they meet the requirements of their instructors for the omitted exercises. For every unexcused absence from any class exercise in excess of those allowed, a deduction from the mark obtained in the course in which the absences occurred will be made.

Advisers.—Advisers are appointed for all students, to be of such aid and assistance as they can both inside and outside of school hours. The head of the department in which a student is registered is adviser to upper-classmen, and instructors in charge of freshmen classes act as advisers to freshmen.

Conduct.—Students are required to return to the proper place all instruments or apparatus used in experimental work, and to leave clean and in working order all machinery and apparatus with which they may experiment. All breakages, accidents or irregularities of any kind must be reported immediately to the head of the department or instructor in charge.

Irregular attendance, lack of punctuality, neglect of either school or home work, disorderly or ungentlemanly conduct or general insubordination are considered good and sufficient reasons for the immediate suspension of a student, and a report to the trustees for such action as they deem necessary to take.

It is the aim of the trustees so to administer the discipline of the Institute as to maintain a high standard of integrity and a scrupulous regard for trust. The attempt of any student to present, as his own, work which he has not performed, or to pass an examination by improper means, is regarded by the trustees as a most serious offense, and renders the offender liable to immediate suspension or expulsion. The aiding or abetting of a student in any dishonesty is also held to be a grave breach of discipline.

Any student who violates these provisions will be immediately suspended by the president, and the case reported at the following meeting of the trustees for action.

Examinations.—For first-year students examinations are held every five weeks, and these serve to inform the student concerning his standing and the progress made.

For students in upper classes examinations will be held during the eighth week of each term.

Final examinations are held at the end of each term.

In general, the examinations cover the work of the preceding term, but at the discretion of the instructor may include work of earlier terms.

Examinations for students conditioned in first-term subjects are held during the second term, and examinations for students conditioned in the second-term subjects are held in September following. Students requesting condition examinations at other than scheduled dates will be required to pay $5 for each examination so taken.

Any student who fails to complete a subject satisfactorily or to clear a condition

at the time appointed, will be required to repeat the subject, and he cannot be admitted to subjects dependent thereon.

A student whose term's standing is as a whole so low that he cannot continue with profit the work of the next term will be required to leave, but he may return the following year to repeat such subjects as are required.

Daily work and regularity of attendance are considered in making up the reports of standing.

Records and Reports of Standing.—During each term informal reports are sent to parents or guardians of all students under age, and to all students; and at the end of each term formal reports are made.

The daily work of the student forms an important part of his record, and no pupil will be awarded the diploma or degree unless this portion of his record is clear.

Books are prescribed for study, for entry of lecture notes and other exercises, and are periodically examined by the lecturers. The care and accuracy with which these books are kept are considered in determining standing.

Thesis.—Each candidate for the degree of the Institute must file with the head of the department in which the thesis is taken, and not later than May 15, a report of original investigation or research, written on a good quality of paper, 8½ by 11 inches, with one-inch margin at left, and one-half inch at right, of each page; such thesis to have been previously approved by the head of the department in which it is made.

For all candidates for the diploma this requirement will be optional on the part of the Institute.

Library and Reading Room.—That the students may have surroundings conducive to reading and study a moderate-sized reading room with library tables and chairs has been provided. The library shelves contain textile, art, engineering and scientific publications. These are increased from time to time as new technical books of value to textile students are issued from the press. The leading textile papers are kept on file for ready reference.

FEES, DEPOSITS, ETC.

Tuition Fee.—The fee for the day course is $150 per year for residents of Massachusetts. For non-residents the fee for all courses is $200 per year. The fee for students from foreign countries is $300 per year.

Three-fifths of the fee is charged for a single term. Each term's tuition is payable during the first week of that term. Students failing to make this payment at the specified time will be excused from classes until satisfactory explanation and arrangements for payment can be made. *No bills will be sent.* After payment is made no fee or part thereof can be returned, except by special action of the trustees.

Special students pay, in general, the full fee, but if a course be taken involving attendance at the school during a limited time, application may be made to the president for a reduction.

Students entering from Massachusetts are required to file with the Bursar a statement signed by either town or city clerk, stating that the applicant's father is a legal resident of Massachusetts.

Athletic Fee.—An athletic fee of $15 is due and payable at the time of the first payment of tuition.

Deposits.—For all first-year students a minimum deposit of $25 is required to cover the cost of breakage, supplies, apparatus and chemicals used in the Chemical Laboratory, the unexpended balance to be returned to the student at the end of the year. For all students in second, third, and fourth years taking work in Chemistry and Dyeing Laboratories a deposit of $25 for the first term and $25 for the second term is required.

Students taking Machine Shop will be required to make deposit of $15 to cover cost of materials, supplies and breakage. Included in this charge is a kit of tools which is essential to the work and which becomes the personal property of the student. The unexpended balance will be returned at the end of the year.

Students not taking Chemistry Laboratory or Machine Shop will be required to make a deposit of $10 each year to cover general breakage. The unexpended balance will be returned at the end of the year.

All deposits must be made before students can be admitted for laboratory work.

Rooms and Board.—Students from a distance, requiring rooms and board in the city, may, if they desire, select same from a list which is kept at the Institute. The cost of rooms and board in a good district is $12 per week and upwards.

Books and Materials.—Students must provide their own books, stationery, tools, etc., and pay for any breakage or damage that they cause. The above fee includes free admission for any day students desiring to attend any of the evening classes in which there is accommodation.

Each student must provide himself with proper outer garments and wear them in such a manner when working in the various laboratories that clothing and person will be protected and not endangered by moving machinery or chemicals.

All raw stock and yarn furnished to the students, and all the productions of the Institute, remain or become its property, except by special arrangement; but each student is allowed to retain specimens of yarn or fabrics that he has produced, if mounted and tabulated in accordance with the requirements of the department. It is understood that the department may retain such specimens of students' work as they may determine.

Lockers are provided for the use of the students, sufficiently capacious to contain clothing, books and tools.

No books, instruments or other property of the Institute are loaned to the students to be removed from the premises except by special permission.

Summary of Expenses per Year

Tuition (residents of Massachusetts)	$150
Tuition (residents of other States)	200
Tuition (foreigners)	300
Chemistry laboratory deposit (1st year)	25
Chemistry laboratory deposit (2d, 3d and 4th years)	50
Athletic fee	15
Machine shop deposit	15
General breakage fee	10
(This applies to students who do not take chemistry or machine shop.)	
Books and supplies	50
(Books and supplies for the first year cost about $80, second and third year $35, and fourth year $50, thus averaging about $50 per year for the four years.)	

SCHOLARSHIPS AND PRIZES

The Massachusetts Charitable Mechanic Association Scholarship.—The Massachusetts Charitable Mechanic Association has offered three scholarships of $250 each which are for the purpose of defraying school expenses of such students as may be selected by a committee composed of a representative from the association, one from the Board of Trustees and the President of the Institute.

Louis A. Olney Book Prizes.—Prizes in the form of books are awarded each year to the successful candidate on graduation day. The conditions in detail are as follows:—

First.—Ten dollars to the student taking the regular Chemistry and Textile Coloring Course who shall be considered as having attained the highest scholarship in first-year chemistry.

Second.—Five dollars to the student taking the regular Chemistry and Textile Coloring Course who shall be considered as having attained the second highest scholarship in first-year chemistry.

Third.—Ten dollars to the regular student of the Chemistry and Textile Coloring Course who shall be considered as having obtained the highest scholarship during his second year.

Fourth.—Five dollars to the regular student of the Chemistry and Textile Coloring Course who shall be considered as having attained the second highest scholarship during his second year.

Fifth.—Ten dollars to the student graduating from the Chemistry and Textile Coloring Course, who, in the opinion of the instructing staff of the department, shall have maintained the highest scholarship throughout the course.

The above-mentioned sums are to be invested in books which may be selected after graduation. In case no one is considered worthy of any particular scholarship prize, or if there is no competition, the same may be withheld. The decision in such case shall rest with the judges.

The National Association of Cotton Manufacturers Medal.—The National Association of Cotton Manufacturers offers a medal to that member of the graduating class who, during his course, shall have attained the highest standing in special subjects required by the vote of the association.

STUDENT ACTIVITIES AND ORGANIZATIONS

School Publications.—The Text is issued bi-weekly and it contains news pertaining to activities in the Institute as well as information concerning alumni. The Pickout is an annual publication in charge of a manager and editor selected from the senior class. The board is composed of representatives from the various classes.

Fraternities.—There are four fraternities, three of which are national and one is local. They afford opportunity for social life desired in a college career.

Dramatic Club.—The Dramatic Club gives annually a theatrical program at the Lowell Auditorium. Appropriation is made from the profits to the treasury of the Athletic Association.

Professional Clubs.—A Student Section of the American Society of Mechanical Engineers holds meetings regularly in accordance with requirements of the national organization. The Student Section of the American Society of Dyers and Colorists hold meetings at which papers are delivered or speakers come from outside the school organization.

Rifle Club.—The rifle club offers opportunity to all students to attain proficiency in marksmanship and selects the team for interscholastic matches with other colleges.

Honor Society.—To degree candidates who have maintained a high scholarship for three years' work, or who have met with certain similar requirements, is accorded the honor of membership in the society Tau Epsilon Sigma. Relatively a membership in this society corresponds to that in some of the well-known honor societies of the liberal arts and scientific colleges. It requires constant attendance and application to the work of the course for any student to reach the scholarship level entitling him to this membership.

Honor Roll.—The President's List includes upper classmen taking a regular course who have a general average of eighty percent and no deficiencies.

Co-operative Society.—This society is maintained for the benefit of students who desire to purchase supplies and materials for use in connection with their work. It is operated under the direction of a manager and assistant manager and one or more clerks. The general business policy is under the supervision of a member of the faculty. Students who join the society are entitled to discount privileges when purchasing from the society and from certain firms in the city of Lowell.

Alumni Association.—The Alumni Association of the Institute holds its annual meeting and banquet in May of each year.

The membership of the association is composed of graduates of the day courses and is open to any non-graduate who has attended the Institute for at least one year.

Officers for the Year 1932–33

Arnold J. Midwood, '05, *President*
Walker F. Prescott, '09, *Vice-President*
Arthur A. Stewart, '00, *Secretary-Treasurer*

Communications should be addressed to Arthur A. Stewart, Lowell Textile Institute.

Ex-Officio Members of Executive Committee

Edward M. Abbot, '04
Henry A. Bodwell, '00
Charles W. Churchill, '06
Thomas T. Clark, '10
Stanley H. Wheelock, '05
Royal P. White, '04

Executive Committee

15 *Members*

Philip H. Warren, '05
Alexander Campbell, '23
James F. Dewey, '04
Leonard S. Farr, '08
Russell T. Fisher, '14
Olin D. Gay, '08
Brackett Parsons, '20
Everett B. Rich, '11
Richard M. Sawyer, '27
Dean W. Symmes, '22
Ernest D. Walen, '14
J. Milton Washburn, '21
A. Edwin Wells, '20
Edward L. Wingate, Jr., '28

SUBJECTS OF INSTRUCTION

In the column headed "Hours of Exercise" the numbers represent for each particular subject the total hours required in school for a period of fifteen weeks.

The letter and number which follow the subjects indicate the department in which the subject is given and the number of the subject in that department. For detailed description of the same, see page 34.

The departments are indicated as follows:—

Textile Engineering	B	Cotton Yarns	F
Chemistry and Textile Coloring	C	Woolen and Worsted Yarns	G
Textile Design and Power Weaving	D	Finishing	H
Languages and History	E		

By referring to the letter and number indicated under "Preparation" the student can ascertain what subjects are necessary in order that he may have a clear understanding of the subject which he is scheduled to take.

First Year

First Term

(Common to all Courses)

	Hours of Exercise
Elementary Chemistry C–10	105
English E–10	45
Mathematics B–10	60
Mechanical Drawing B–13	135
Physics B–11	75
Physical Education	30
Textile Design and Cloth Analysis D–10	75

Second Term

	Course IV	Course VI
Elementary Chemistry C–10	120	120
Elementary German E–11	30	–
English E–10	45	45
Machine Drawing B–14 or B–14a	45	120
Mathematics B–10	60	60
Mechanism B–12	60	60
Physical Education	30	30
Qualitative Analysis C–11	135	–
Textile Design and Cloth Analysis D–10	–	90

For second-term subjects in Courses I, II, and III, see pages 21, 23, 25.

Course I.—Cotton Manufacture

The Cotton Manufacturing Course is designed for students contemplating a career in the manufacturing of cotton yarns, cloth or allied industries, and wishing to devote but three years to instruction at the Institute.

During the first term the studies are common to all courses, and include instruction in mathematics, mechanical drawing, physics, textile design and elementary chemistry.

During the second term, lectures in organic chemistry are given followed by lectures in textile chemistry and dyeing the second year. The work in mechanism serves as a basis for all future machine and mechanical work, and is followed by steam engineering, electricity and mill engineering. The course in textile designing, cloth analysis and cloth construction includes lectures on plain, fancy and Jacquard weaves, the analysis of all commercial fabrics, and designs for the same.

Power weaving is taken up during the second and third years. Commencing with lectures and practice upon plain looms, the instruction continues with dobby, box-loom, and Jacquard weaving.

A course in knitting taken during the third year includes the manufacture of flat goods, hosiery and underwear. Considerable laboratory practice accompanies the lecture work, giving the students actual working knowledge of a wide range of knitting machines. Instruction in the finishing of cotton fabrics is given by lectures and laboratory work, and requires considerable work on standard machines in the laboratory. Textile testing, also given in the third year, instructs the student in standard methods for physical testing of textile material.

The course in cotton carding is given in the second year. The instruction covers the production of cotton throughout the world, the classing of various cottons and the various methods of marketing the cotton crop. Particular emphasis is given to the American cotton crop. The treatment of cotton in the mill processes covers all the operations preparatory to spinning, for the regular cotton system and for the cotton waste systems. Opening, picking, carding, combing, drawing and roving are the operations included. Lectures supplement the material available in text books in order to have the course up to date. Considerable time is spent in the laboratory studying cotton fibers, classing, processing stock and making various tests on the adjustment of machines and the effect on the quality of the work produced.

The third year's work continues that of the second year, with detailed study of spinning, spooling, twisting and winding. Another course gives instruction in mill organization, balancing and arranging machinery in the mill. Finally, a brief course is given in the use of the microscope and camera in studying various problems in cotton manufacture. Laboratory practice supplements the lecture course, giving practical operation, adjustment and observation of the machines studied. Advanced laboratory work illustrates the methods of study and analysis of the more general and complex problems such as are usually handled in the laboratory of a textile plant.

During both the second and third years, particular attention is given to the preparation of the various reports in order that the student may learn proper methods for presenting data and conclusions resulting from mill studies and tests.

During the third year, each student makes some original study, usually of a technical nature. He must make a formal report of this study satisfactory to the faculty before receiving his diploma.

For detailed description of the subjects see page 34.

Course I.—Cotton Manufacture

[For first term see page 19]

First Year. Second Term. (Hours of Exercise)

Elementary Chemistry C–10	120	Mechanism B–12	60
English E–10	45	Physical Education	30
Machine Drawing B–14	120	Textile Design and Cloth Analysis D–10	90
Mathematics B–10	60		

Second Year. First Term

Cotton Yarn Manufacture F–20	255	Textile Chemistry and Dyeing Lect. C–20	30
Physics B–23a	45	Textile Design and Cloth Construction D–20	75
Power Weaving D–24	90		
Steam Engineering B–24	30		

Second Year. Second Term

Cotton Yarn Manufacture F–20	225	Textile Chemistry and Dyeing Lect. C-20	30
Physics B–23a	45	Textile Design and Cloth Construction D–20	75
Power Weaving D–24	150		

Third Year. First Term

Cotton Finishing H–31	75	Mill Engineering B–34a	30
Cotton Organization F–32	60	Power Weaving D–32	135
Cotton Yarn Manufacture F–30	165	Textile Testing G–31	30
Electricity B–31a	30	Thesis F–34.	

Third Year. Second Term

Cotton Finishing H–31	75	Power Weaving D–32	120
Cotton Yarn Manufacture F–30	210	Thesis F–34.	
Knitting F–31	120		

Course II.—Wool Manufacture

The course on wool manufacturing is arranged for those who contemplate a career in the manufacture of woolen or worsted fabrics, and can devote but three years to the school work. It includes instruction on all of the varied processes employed in manipulating the wool fiber to produce yarn and cloth, namely, sorting, scouring, carding, combing, spinning, designing, weaving, dyeing and finishing. The work is carried on by lectures, recitations and practical work in the laboratories.

Beginning with the second year the details of manipulating wool from the grease to the finished yarn is taken up for close study. This includes the spinning of woolen yarn, also worsted yarn, by both the English and the French systems. The intermediate processes of sorting, scouring, carding, combing and top-manufacturing are taken in detail and in proper sequence.

The general chemistry of the first year is followed by a lecture course in the second year on textile chemistry and dyeing.

Textile design, cloth analysis and construction are continued from the first year throughout the course, the work being applied especially to woolen and worsted goods. Weaving on power looms commences in the second year and continues through the third.

A course in knitting taken during the third year includes the manufacture of flat goods, hosiery and underwear. Considerable laboratory practice accompanies the lecture work, giving the students actual working knowledge of a wide range of knitting machines.

Lectures on finishing commence with the third year and are augmented by extensive practice with the machines in the Finishing Department.

Work in the Engineering Department extends throughout all three years, and includes mechanical drawing, steam engineering and electricity. The practical application of the principles studied in these subjects is brought out forcibly in the work on mill engineering, where mill design and construction are considered. A short course covering methods employed in the testing of fibers, yarns, and cloths, together with laboratory work in the manipulation of certain physical apparatus, is given in the third year.

For detailed description of the subjects see page 34.

Course II.—Wool Manufacture

[For first term see page 19]

First Year. Second Term. (Hours of Exercise)

Elementary Chemistry C–10	120	Mechanism B–12	60
English E–10	45	Physical Education	30
Machine Drawing B–14	120	Textile Design and Cloth Analysis D–10	90
Mathematics B–10	60		

Second Year. First Term

Fiber Preparation G–20–21	240	Textile Chemistry and Dyeing Lect. C–20	30
Physics B–23a	45	Textile Design and Cloth Construction D–21	75
Power Weaving D–24	105		
Steam Engineering B–24	30		

Second Year. Second Term

Fiber Preparation G–20–21	270	Textile Chemistry and Dyeing Lect. C-20.	30
Physics B–23a	45	Textile Design and Cloth Construction D–21	60
Power Weaving D–24	120		

Third Year. First Term

Electricity B–31a	30	Textile Testing G–31	30
Mill Engineering B–34a	30	Woolen and Worsted Finishing H–30	75
Power Weaving D–32	135	Worsted Yarn Manufacture G–30	225

Third Year. Second Term

Knitting F–31	120	Worsted Yarn Manufacture G–30	225
Power Weaving D–32	105	Thesis.	
Woolen and Worsted Finishing H–30	75		

Course III.—Textile Design

The general course in textile design is planned to meet the demand of young men for a technical training in the general processes of textile manufacturing, but with particular reference to the design and construction of fabrics. To this end a foundation is laid in the first year by instruction in the elementary principles of designing, decorative art and weaving. That he may later in the course pursue to advantage instruction in yarn manufacturing, weaving, dyeing, finishing and some engineering problems, a foundation course in mechanics, mathematics and chemistry is laid. As the student is required to pursue courses in the yarn departments, both cotton and wool, he acquires a knowledge of the manufacture of cotton yarns from the bale to the yarn, and of woolen and worsted yarns from the fleece through the varied processes of manufacturing woolen yarn or worsted yarn by both the French and Bradford systems.

Throughout his entire course he receives instruction in design, cloth analysis and construction of all the standard cloths, viz., trouserings, coatings, suitings, blankets, velvets, corduroys, plushes, etc. This is followed by advanced work in Jacquard designing and weaving, which serves not only to acquaint the student with the many kinds of cotton, woolen, worsted and silk fabrics of figured design, but stimulates and develops any artistic talent he may possess. Decorative art becomes an important part of the work of the second and third years.

The course in general inorganic and organic chemistry of the first year leads to the subject of textile chemistry and dyeing in the second year.

Power weaving commences with the second year and continues throughout the course, and work on all types of looms is required.

During the third year the student receives instruction in the finishing of cotton goods and woolen and worsted cloths. This instruction is given by means of lecture and laboratory work.

The engineering subjects given in the second and third years are intended to acquaint the student with such general knowledge as will be of assistance should he be called upon in later life to be a mill manager, or should his subsequent progress lead to some executive position in the operation of a textile plant.

For detailed description of the subjects see page 34.

Course III.—Textile Design

[For first term see page 19]

FIRST YEAR. SECOND TERM. (HOURS OF EXERCISE)

Elementary Chemistry C–10	120	Mechanism B–12	60
English E–10	45	Physical Education	30
Machine Drawing B–14	120	Textile Design and Cloth Analysis D–10	90
Mathematics B–10	60		

SECOND YEAR. FIRST TERM

Cotton Yarn Manufacture F–20a	90	Textile Chemistry and Dyeing Lect. C–20	30
Physics B–23a	45	Textile Design and Cloth Construction D–20, 21	240
Power Weaving D–24	90		
Steam Engineering B–24	30		

SECOND YEAR. SECOND TERM

Cotton Yarn Manufacture F–20a	45	Textile Chemistry and Dyeing Lect. C-20	30
Fiber Preparation G–20–21	90	Textile Design and Cloth Construction D–20, 21	135
Jacquard Design D–23	75		
Physics B–23a	45		
Power Weaving D–24	105		

THIRD YEAR. FIRST TERM

Cotton Finishing H–31	75	Textile Testing G–31	30
Cotton Yarn Manufacture F-30a	60	Woolen and Worsted Finishing H–30	75
Power Weaving D–32	60	Worsted Yarn Manufacture G–30	90
Textile Design and Cloth Construction D–30	135		

THIRD YEAR. SECOND TERM

Cotton Finishing H–31	75	Textile Design and Cloth Construction D–30	75
Cotton Yarn Manufacture F-30a	60	Woolen and Worsted Finishing H–30	75
Jacquard Design D–31	75	Worsted Yarn Manufacture G–30	60
Power Weaving D–32	105	Thesis.	

Course IV.—Chemistry and Textile Coloring

The four-year course in Chemistry and Textile Coloring, leading to the degree of B.T.C., is especially intended for those who wish to engage in any branch of textile chemistry, textile coloring, bleaching, finishing or the manufacture and sale of the dyestuffs or chemicals used in the textile industry. The theory and practice of all branches of dyeing, printing, bleaching, scouring and finishing are taught by lecture work supplemented by a large amount of experimental laboratory work and actual practice in the dyehouse and finishing room.

The underlying theories and principles of chemistry are the same, no matter to what industry the application is eventually made. Furthermore, no industry involves more advanced and varied applications of the science of chemistry than those of the manufacture and application of the coal-tar coloring matters. In addition, the textile colorist must consider the complex composition of the textile fibers, and the obscure reactions which take place between them and the other materials of the textile industry.

During the first year general chemistry, including both inorganic and organic, is taught by lectures and laboratory work, and this is supplemented during the second term by qualitative analysis and stoichiometry.

Advanced inorganic chemistry, as well as advanced organic chemistry, is studied during the second and third year as a continuation of the elementary chemistry of the first year, and much time is spent upon quantitative analysis, industrial chemistry, and textile chemistry and dyeing.

The foundation work in general chemistry is continued during the third year with courses in physical chemistry, organic laboratory work and analytical work. The subject of industrial chemistry is introduced, and much time is devoted to advanced textile chemistry, dye testing, color matching, calico printing, and woolen, worsted and cotton finishing.

The fourth year is characterized by an endeavor to present certain subjects of a more applied nature in such a manner that the student's reasoning power and ability to apply the knowledge gained during the first three years may be developed to the fullest extent. The subject of engineering chemistry is introduced, and the work in the dyeing and analytical laboratories is applied as far as possible to the actual requirements of the factory chemist and colorist. Much time is also spent in the organic chemistry laboratory, particular attention being given to the preparation of typical dyestuffs. Thorough courses are given in microscopy, photomicrography and the use of various instruments such as the spectroscope, ultra-microscope, polariscope, tintometer and other optical instruments applicable to experimental work in connection with the textile industry. Courses are also given in report writing and textile literature.

During this fourth year the student has an opportunity to take several optional subjects of an advanced nature and conduct such research work and original investigation as time may permit.

For detailed description of the subjects see page 34.

Course IV.—Chemistry and Textile Coloring

[For first year see page 19]

Second Year. First Term. (Hours of Exercise)

Advanced German E–21	45	Quantitative Analysis C–23	130
Adv. Organic Chemistry C–22	30	Stoichiometry C–24	15
English E–20	30	Textile Chemistry and Dyeing Lab. C–21	90
Mathematics B–20a	45	Textile Chemistry and Dyeing Lect. C–20	45
Physics B–23	65		
Power Weaving D–23	15		

Second Year. Second Term

Advanced German E–21	45	Stoichiometry C–24	15
Adv. Organic Chemistry C–22	30	Textile Chemistry and Dyeing Lab. C–21	120
English E–20	30	Textile Chemistry and Dyeing Lect. C–20	45
Mathematics B–20a	45		
Physics B–23	65		
Quantitative Analysis C–23	130		

Third Year. First Term

Adv. Organic Chemistry Lect. C–34	15	Economics E–30	45
Adv. Textile Chemistry and Dyeing Lab. C–32	135	Physical Chemistry C–33	45
Adv. Textile Chemistry and Dyeing Lect. C–32	30	Quantitative Analysis C–30	150
		Technical German C–35	30
		Woolen and Worsted Finishing H–30	75

Third Year. Second Term

Adv. Textile Chemistry and Dyeing Lab. C–32	75	Physical Chemistry C–33	45
Adv. Textile Chemistry and Dyeing Lect. C–32	15	Photography C–37	15
Economics E–30	45	Quantitative Analysis C–30	105
Industrial Chemistry C–31	30	Technical German C–35	30
Organic Laboratory C–36	90	Woolen and Worsted Finishing H–30	75

Fourth Year. First Term

Adv. Textile Chemistry and Dyeing Lab. C–44	90	Microscopy and Photomicroscopy C–45	60
Adv. Textile Chemistry and Dyeing Lect. C–44	30	Options or Thesis C–52	90
Chemical Textile Testing C–43	45	Organic Laboratory C–41	90
Industrial Chemistry C-42	30	Quantitative Analysis C–46	15
		Report Writing C–47	15
		Technical German C–40	30
		Textile Marketing B–42	30

Fourth Year. Second Term

Advanced General Chemistry C–49	30	Options or Thesis C–52	90
Adv. Textile Chemistry and Dyeing Lab. C–44	90	Organic Laboratory C–41	105
Adv. Textile Chemistry and Dyeing Lect. C–44	15	Rayon Manufacturing C–51	30
Chemical Textile Testing C–43	45	Technical German C–40	30
Engineering Chemistry C–50	45	Technology of Wool and Allied Fibers G-40	15
		Textile Literature C–48	15

Course VI.—Textile Engineering

This course is the four-year general textile course leading to the degree of Bachelor of Textile Engineering (B.T.E.), and aims especially to fit men, in the broadest possible manner, to meet the increasing demands of every branch of the textile industry for men with combined textile and technical preparation. The magnitude and scope of the textile and allied industries fully justify the most thorough technical training possible for all who aspire to leadership in this field.

The student is first thoroughly grounded in those fundamental principles of science upon which all industrial and engineering work rests. The foundation of his textile and technical training is in the subjects of mathematics, physics, chemistry, drawing, mechanics, mechanism, and technology of fibers, and their practical application.

Instruction is given in all the various branches of textile manufacturing through lectures, recitations and laboratory work. A large proportion of his time is spent in well-equipped textile departments where he studies and operates all of the machinery required in the conversion of cotton and wool fiber into yarns and fabrics. This includes cotton, wool and worsted yarn manufacturing, designing, weaving, knitting, dyeing and finishing. In his last year the course in textile testing acquaints the student with the methods for determining the physical properties of textile fibers, yarns and fabrics.

To properly equip the student to meet the varied engineering problems which confront the mill manager or executive, or to so train him that he may enter those industries closely allied to the textile, instruction is given by lecture and laboratory practice in the several branches of engineering.

Steam engineering considers the problems involved in steam generation and distribution for power, heating and manufacturing purposes, and includes the testing of laboratory and power plant equipment. The course in electrical engineering treats of the generation and transmission of electrical power, the testing of direct and alternating current machinery, and is intended to acquaint the student with modern practice.

Mill engineering familiarizes the student with mill design, construction, heating, lighting, humidification and fire protection. The arrangement of machinery and buildings for most efficient production and economical power distribution is also studied in detail.

The broadening effect of such subjects as English and economics is carried still further in this course by carefully planned courses in business administration, accounting, cost accounting and business law.

During the fourth year the student is required to conduct an original investigation of some textile or allied problem, and to submit the results in the form of a satisfactory thesis before receiving his degree.

For the student who may desire the breadth of technical training which this course offers, but who wishes to specialize in either cotton or wool manufacturing, two options are offered. In these optional courses the student's entire textile time is devoted to the study of that particular fiber which he elects. Provision is also made for the substitution of knitting for weaving laboratory time in the case of those who prefer to lay more emphasis on knit fabrics.

During the past few years a demand has come from the distributing or marketing branches of the textile business for men with a four years' technical training. With the idea of offering courses which may better prepare graduates to meet this new call, the new Sales Option Course is offered.

There are also requests for a four-year Design Course which, while majoring in Textile Design, includes other subjects that help to make a broader course than the one of three years' duration. For this purpose the Design Option Course is offered. Like the other courses outlined, these will be subject to changes to meet new demands.

For detailed description of subjects, see page 34. The curricula of the several optional courses will be found on pages 29 to 33.

Course VI.—Textile Engineering (General Course-G)

[For first year see page 19]

Second Year. First Term. (Hours of Exercise)

Cotton Yarn Manufacture F-20a	60	Physics B-23	75
Fiber Preparation G-20, 21	120	Textile Chemistry and Dyeing Lecture C-20	30
Machine Drawing B-21	60	Textile Design and Cloth Construction D-22	45
Machine Shop B-26	75		
Mathematics B-20	60		

Second Year. Second Term

Applied Mechanics B-25	45	Physics B-23	75
Cotton Yarn Manufacture F-20a	60	Power Weaving D-24	75
Fiber Preparation G-20, 21	90	Textile Chemistry and Dyeing Lect. C-20	30
Machine Drawing B-21	90		
Mathematics B-20	60		

Third Year. First Term

Applied Mechanics B-30	45	Power Weaving D-32	60
Cotton Yarn Manufacture F-30a	60	Worsted Yarn Manufacture G-30	90
Economics E-30	45	Woolen and Worsted Finishing H-30	75
Electrical Engineering B-31	75		
Heat Engineering B-32	75		

Third Year. Second Term

Cotton Yarn Manufacture F-30a	60	Mill Engineering B-34	90
Economics E-30	45	Worsted Yarn Manufacture G-30	90
Electrical Engineering B-31	75	Woolen and Worsted Finishing H-30	75
Heat Engineering B-33	90		

Fourth Year. First Term

Accounting B-40	90	Mill Engineering B-45	75
Cotton Organization F-32	90	Textile Marketing B-42	30
Electives B-48		Textile Testing B-43	45
Electrical Engineering B-44	75	Thesis	75
Microscopy B-41	45		

Fourth Year. Second Term

Business Administration B-46	90	Knitting F-31a	30
Cotton Finishing H-31	105	Mill Engineering B-45	75
Electives B-48		Mill Illumination B-47	45
Electrical Engineering B-44	75	Thesis	105

Course VI.—Textile Engineering (Cotton Option-C)

[For first year see page 19]

Second Year. First Term. (Hours of Exercise)

Cotton Yarn Manufacture F–20a	225	Physics B–23	75
Machine Drawing B–21	90	Textile Chemistry and Dyeing Lecture C–20	30
Machine Shop B–26	45		
Mathematics B–20	60		

Second Year. Second Term

Applied Mechanics B–25	45	Physics B–23	75
Cotton Yarn Manufacture F–20a	165	Power Weaving D–24	105
Machine Drawing B-22	45	Textile Chemistry and Dyeing Lect. C-20.	30
Mathematics B–20	60		

Third Year. First Term

Applied Mechanics B–30	45	Heat Engineering B–32	75
Cotton Finishing H–31	75	Power Weaving D–32	45
Cotton Yarn Manufacture F–30a	120	Textile Design and Cloth Construction D–20	45
Economics E–30	45		
Electrical Engineering B–31	75		

Third Year. Second Term

Cotton Finishing H–31	75	Heat Engineering B–33	90
Cotton Yarn Manufacture F–30a	120	Mill Engineering B–34	90
Economics E–30	45	Textile Design and Cloth Construction D–20	30
Electrical Engineering B–31	75		

Fourth Year. First Term

Accounting B–40	90	Textile Design and Cloth Construction D–30	30
Cotton Organization F–32	105	Textile Marketing B–42	30
Electives B–48		Textile Testing B–43	45
Electrical Engineering B–44	75	Thesis	75
Microscopy B–41	45		
Mill Engineering B–45	30		

Fourth Year. Second Term

Business Administration B-46	90	Mill Illumination B–47	45
Electives B–48		Textile Design and Cloth Construction D–30	45
Electrical Engineering B–44	75	Thesis	135
Knitting F–31a	105		
Mill Engineering B–45	30		

Course VI.—Textile Engineering (Wool Option-W)

[For first year see page 19]

Second Year. First Term. (Hours of Exercise)

Fiber Preparation G–20, 21	225	Mathematics B–20	60
Machine Drawing B-21	90	Physics B–23	75
Machine Shop B–26	45	Textile Chemistry and Dyeing Lecture C–20	30

Second Year. Second Term

Applied Mechanics B–25	45	Physics B-23	75
Fiber Preparation G–20, 21	165	Power Weaving D–24	105
Machine Drawing B-22	45	Textile Chemistry and Dyeing Lect. C-20	30
Mathematics B–20	60		

Third Year. First Term

Applied Mechanics B-30	45	Power Weaving D-32	60
Economics E–30	45	Worsted Yarn Manufacture G–30	150
Electrical Engineering B-31	75	Woolen and Worsted Finishing H–30	75
Heat Engineering B-32	75		

Third Year. Second Term

Economics E–30	45	Worsted Yarn Manufacture G–30	150
Electrical Engineering B-31	75	Woolen and Worsted Finishing H–30	75
Heat Engineering B–33	90		
Mill Engineering B–34	90		

Fourth Year. First Term

Accounting B–40	90	Textile Design and Cloth Construction D–21	75
Electives B–48		Textile Marketing B–42	30
Electrical Engineering B–44	75	Textile Testing B–43	45
Microscopy B–41	45	Thesis	135
Mill Engineering B–45	30		

Fourth Year. Second Term

Business Administration B–46	90	Mill Illumination B–47	45
Electives B–48		Textile Design and Cloth Construction D–21	60
Electrical Engineering B–44	75	Thesis	195
Knitting F–31a	30		
Mill Engineering B–45	30		

Course VI.—Textile Engineering (Design Option-D)

[For first year see page 19]

Second Year. First Term. (Hours of Exercise)

Cotton Yarn Manufacture F–20a	60	Textile Chemistry and Dyeing Lecture C–20	30
Fiber Preparation G–20, 21	75	Textile Design and Cloth Construction D–20, 21	225
Mathematics B–20	60		
Physics B–23	75		

Second Year. Second Term

Cotton Yarn Manufacture F–20a	60	Power Weaving D–24	105
Fiber Preparation G–20, 21	90	Textile Chemistry and Dyeing Lect. C-20	30
Mathematics B–20	60	Textile Design and Cloth Construction D–20, 21	105
Physics B–23	75		

Third Year. First Term

Cotton Yarn Manufacture F–30a	60	Worsted Yarn Manufacture G–30	90
Economics E–30	45	Woolen and Worsted Finishing H–30	75
Power Weaving D–32	120		
Textile Design and Cloth Construction D–30	135		

Third Year. Second Term

Cotton Yarn Manufacture F–30a	60	Textile Physics B–37	75
Economics E–30	45	Worsted Yarn Manufacture G–30	90
Power Weaving D–32	105	Woolen and Worsted Finishing H–30	75
Textile Design and Cloth Construction D–30	75		

Fourth Year. First Term

Accounting B–40	90	Textile Marketing B–42	30
Jacquard Design and Weaving D-40	90	Textile Styling B–50	30
Microscopy B–41	45	Textile Testing B-43	45
Textile Design and Cloth Construction D-41	120	Thesis	75

Fourth Year. Second Term

Business Administration B–46	90	Textile Design and Cloth Construction D-41	120
Cotton Finishing H–31	105	Thesis	90
Jacquard Design and Weaving D-40	120		

Course VI.—Textile Engineering (Sales Option-S)

[For first year see page 19]

Second Year. First Term. (Hours of Exercise)

Cotton Yarn Manufacture F–20a	60	Textile Chemistry and Dyeing Lecture C–20	30
Fiber Preparation G–20, 21	75	Textile Design and Cloth Construction D–20, 21	225
Mathematics B–20	60		
Physics B–23	75		

Second Year. Second Term

Cotton Yarn Manufacture F–20a	60	Textile Chemistry and Dyeing Lect. C-20	30
Fiber Preparation G–20, 21	90	Textile Design and Cloth Construction D–20, 21	105
Mathematics B–20	60		
Physics B–23	75		
Power Weaving D–24	105		

Third Year. First Term

Cotton Yarn Manufacture F–30a	60	Textile Design and Cloth Construction D–30	135
Economics E–30	45	Worsted Yarn Manufacture G–30	90
Power Weaving D–32	75	Woolen and Worsted Finishing H–30	75
Principles of Marketing B–35	45		

Third Year. Second Term

Cotton Yarn Manufacture F–30a	60	Textile Physics B–37	75
Economics E–30	45	Worsted Yarn Manufacture G–30	90
Marketing Methods B–36	75	Woolen and Worsted Finishing H–30	75
Power Weaving D-32	30		
Textile Design and Cloth Construction D–30	75		

Fourth Year. First Term

Accounting B–40	90	Textile Design and Cloth Construction D-41	45
Jacquard Design and Weaving D-40	90	Textile Styling B–50	30
Microscopy B–41	45	Textile Testing B–43	45
Principles of Selling and Advertising B–49	105	Thesis	75

Fourth Year. Second Term

Business Administration B–46	90	Knitting F–31a	75
Cotton Finishing H–31	105	Selling Policies B–52	45
Foreign Trade and Economic Geography B–51	45	Statistics B–53	45
		Thesis	120

SUBJECTS OF INSTRUCTION

TEXTILE ENGINEERING DEPARTMENT—B

The various options are designated by G, C, W, D, S.

Mathematics—B-10. Preparation: Admission Requirements. The work in the first term consists of algebra, plane trigonometry, and instruction in the use of the slide-rule. Algebra is reviewed through quadratics and then logarithms are taken. In plane trigonometry, right and oblique triangles are solved by means of natural and logarithmic functions, and the various algebraic relations among the trigonometric functions are proved and used in identities and equations. Significant figures and the use of approximate data in calculations are also discussed.

In the second term the following topics are taken up: graphical and mathematical solution of quadratic and simultaneous equations, theory of equations, partial fractions, Naperian logarithms, equations of the straight line, equations of various curves, differentiation of algebraic functions, and applications of the derivative. [All courses.]

Physics—B-11. Preparation: Admission Requirements. Taken simultaneously with B-10. This subject is required as a necessary preparation for all courses, and is given during the first term of the first year. The fundamental principles of this subject are considered absolutely essential to a thorough understanding of the operation of all machinery, textile or otherwise. Some of the topics treated in this course are linear and angular velocity, uniform and accelerated motion, mass, momentum, inertia, effect of force in producing motion, centrifugal force, work, power, energy, principle of moments and its applications, parallelogram and triangle of forces with applications, resolution and composition of forces, the mechanical principles represented by the wheel and axle, differential pulley block, common pulley blocks, jackscrew, worm and wheel, and inclined plane.

Laboratory. This course is supplementary to the lecture course and gives the student an opportunity to apply the knowledge gained in the lecture course by performing various experiments. [All courses.]

Mechanism—B-12. Preparation: B-10 and B-11. This subject is also deemed to be one of those absolutely essential to every student's preparation for the work of the following years. Whereas the principles studied are of general application, textile machinery in particular furnishes an unusually large variety of specific examples, and frequent reference is made to these in the development of the course. Some of the important topics covered are gearing and gear train design, belting and pulley calculations, cone and stepped pulley design, cam design, linkages, epicyclic gear trains, and intermittent motion devices. [All courses.[

Mechanical Drawing—B-13. Preparation: Admission Requirements. Taken simultaneously with B-11. This course is taken during the first term of the first year and consists of work in the drawing room supplemented by lectures. This subject is considered of the greatest importance as a preparation for the student's future work, and the practical usefulness of drawing of this character is fully emphasized. The course is systematically laid out covering in order the following divisions:—

Care and use of drawing instruments; geometrical constructions; lettering; elements of projections and descriptive geometry; isometric projection; developments with practical applications; sketching practice on machine details. [All courses.]

Machine Drawing—B-14. Preparation: B-13. This course is the continuation of Mechanical Drawing, and is pursued throughout the second term of the first year. The work is wholly of a practical character, and includes sketching from the textile machinery details and working scale details, tracing and blue-printing. The rudiments of machine design to supplement the work in strength of materials are also given. [Courses I, II, III, VI.]

Machine Drawing—B-14a. Preparation: B-13. This course is similar to B-14, but not so extensive, and is given to students electing the Chemistry and Textile Coloring course. [Course IV.]

Mathematics—B-20. Preparation: B-10. This subject is a continuation of the first year subject B-10, and extends throughout the second year of the engi-

neering course. In the first term the following topics are treated:—derivatives and differentials, the circle, parabola, ellipse, hyperbola, indefinite integrals, summation by integration and applications of integration. In the second term the topics are: differentiation of transcendental functions, methods of integration, centers of gravity, moments of inertia, empirical formulas, and nomographic charts. [Course VI.]

Mathematics—B–20a. Preparation: B–10. This subject is a continuation of the work of the first-year subject B–10. A study of the derivatives and differentials is followed by applications of the differential to rates and errors. Other topics treated are the circle, parabola, ellipse, hyperbola, indefinite integrals, summation by integration, areas, volumes, pressures, exponential, logarithmic, and trigonometric functions. [Course IV.]

Machine Drawing—B–21. Preparation: B–10, B–12, B–14. The work in Machine Drawing is devoted to working detail drawings of textile machinery and advanced graphical mechanism problems. The data for all of these problems are in every case taken directly from some of the textile machines that the students use in other departments. [Course VI, Options G, C, W.]

Machine Drawing—B–22. Preparation: B–10, B–12, B–14. The work in this course consists of advanced graphical mechanism problems. The data for them are in every case taken from some of the textile machines that the students use in other departments. [Course VI, Options C, W.]

Physics—B–23. Preparation: B–10 and B–11. This subject lays the foundation for later work in engineering and chemistry and also explains the general application of the laws and principles of physics. Instruction, consisting of lectures, demonstrations, and recitations, is given for three hours per week during the second year. The topics taken up the first term are:—thermometry, measurement of heat, change of state, expansion, transfer of heat, humidity, hydrostatics, elements of hydraulics, the vernier, kinetic energy, circular motion, harmonic motion, wave motion and sound.

The second term is devoted to the study of light, magnetism, and electricity. Some of the topics are:—nature and propagation of light, reflection and refraction lenses, the telescope and microscope, the spectroscope, color sensation, double refraction, magnetism, electrostatics, fundamental laws of direct currents and electrolysis.

Laboratory. A two-hour period per week for Course VI and a three-hour period every alternate week for Course IV accompanies the class work in this subject and is planned to illustrate precise methods for measuring various physical quantities. [Courses IV, VI.]

Physics—B–23a. Preparation: B–10 and B–11. This subject consists of the same topics as B–23 but does not contain any laboratory work. [Courses I, II, III.]

Steam Engineering—B–24. Preparation: B–12. This course consists of thirty lectures given in the first term of the second year. Its aim is to give those students who do not take the Textile Engineering Course a general knowledge of thermodynamics, the steam engine, steam turbine and gas engine and their auxiliaries, and waste heat reclamation. [Courses I, II, III.]

Applied Mechanics—B–25. Preparation: B–11, B–20. This course is divided into two parts: Graphic Statics and Strength of Materials. The first eight weeks of the semester which is devoted to Graphic Statics consists of the study of mathematical and graphical solutions for any system of forces. Centers of gravity and funicular polygons are introduced followed by roof and bridge truss problems under various conditions of dead, live, wind, and snow loading.

During the second half of the semester and during all the following semester, this course deals with Strength of Materials. So far as time permits, such topics as stress, strain, methods of testing materials, bending moments, shearing force, beam design, torsion, design of shafts, compound beams and columns, combined stresses, and like subjects are considered.

This subject is preparatory to the work in Mill Engineering of both the third and fourth years, at which time its practical value and application are clearly demonstrated. [Course VI, Options G, C, W.]

Machine Shop Practice—B-26. Preparation: B-11 and B-12. Systematic instruction is given in the most approved methods of machine shop practice, the object being to familiarize the student with the proper use of hand and machine tools, and the characteristics of the different materials worked. Particular attention is given to the form, setting, grinding and tempering of tools and the mechanism of the different machines involving certain speeds, feeds, etc. The course is so planned that the instruction in each typical operation shall conform as nearly as possible to commercial machine-shop practice on textile machinery. The list of tools which appears under "Equipment" in this Bulletin gives an idea of the scope of the work, which includes chipping and filing, tool grinding and tempering, straight and taper turning, screw cutting, drilling and boring, planer work, milling machine work, including gear cutting. [Course VI, Options G, C, W.]

Applied Mechanics—B-30. Preparation: B-25. This is a continuation of Applied Mechanics B-25, and is given during the first term of the third year. [Course VI, Options G, C, W.]

Electrical Engineering—B-31. Preparation: B-23. The elementary principles of electricity and magnetism are considered in the lecture course on physics. Their development and application are taken up in this course in a detailed study of the magnetic and electric circuits during the first period of the first term. The second period is devoted to a study of the principles of direct current machinery. The laboratory work consists of a study of technical electrical measurements and dynamo-electric machinery, determining for the latter their operating characteristics.

The second term is devoted entirely to a study of the principles of alternating current circuits, including vector representation, effective values, power, series and parallel circuits. The laboratory work consists of a study of technical electrical measurements, some meter calibration including that of watt-hour meters and a study of alternating current circuits using electrical measuring instruments. Course VI, Options G, C, W.]

Electricity—B-31a. Preparation: B-23a. This is a short course given in the third year of the manufacturing courses, and consists of thirty lectures covering briefly and in a general way the theory of direct and alternating current generators and motors. [Courses I, II.]

Heat Engineering—B-32. Preparation: B-12, B-20. The purpose of this course is to familiarize the student with the principles of elementary thermodynamics, the properties of steam, mechanical mixtures and combustion of fuels. The course consists of thirty exercises given in the first term of the third year. The lectures and recitations are supplemented with illustrative problems assigned for home preparation.

Laboratory. The principles underlying the subjects of steam engineering, hydraulics and thermodynamics are demonstrated in a practical manner in the work in the Engineering Laboratory, given three hours per week. Greater importance is attached to the development of initiative and responsibility in the student than the mere accomplishment of a large number of carefully planned tests. The character of this work is indicated by the following list of experiments and tests:—

Calibration of scales, tanks, gauges, inductors and counters; barrel, separating and throttling calorimeter tests; heat exchange tests; boiler inspection and measurement; flue gas analysis; dynamometer tests; ejector and injector tests; Rankin's efficiency, actual thermal efficiency and duty tests; expansion of pipes, radiation and pipe covering tests; boiler test; trap tests, feed water heating tests; steam, triplex and centrifugal pump tests. [Course VI, Options G, C, W.]

Heat Engineering—B-33. Preparation: B-32. This course is a continuation of B-32, and consists of forty-five hours of lectures and recitations given in the second term of the third year of the Textile Engineering course. The subjects developed are the kinematics of reciprocating steam engines, steam turbines and gas engines. Special attention is given to the mechanical principles on which the

steam engine operates. with detail discussion of the valve gear and governing devices, and the various diagrams used for studying the same. Consideration is given to the underlying heat theory and to the details of construction of the various parts of the machines. During the latter part of the course the historical development, classification and types of turbines and gas engines are discussed.

LABORATORY. The character of the work in the Engineering Laboratory, given three hours per week during the second half of the third year, is indicated by the following list of experiments:—

Boiler inspection and measurement; Rankin's efficiency, actual thermal efficiency and duty tests; boiler test; valve setting by measurement and by indicator; condenser test; non-condensing and condensing engine and turbine tests; heating and ventilating fan tests; lap and butt riveted joint test; nozzle test; gas engine test; flow of air and air compressor tests. [Course VI, Options G, C, W.]

Mill Engineering—B-34. Preparation: B-21, B-25. Mill Engineering, as presented in thirty lectures during the third year of the Textile Engineering course, consists of a discussion of the following topics: the selection of a site for a manufacturing plant; the investigation of the subsoils for the footing course of the foundation; wood; concrete and sheet steel piling; design of walls, beams, floors, windows, doors, stairways and roofs.

Sixty hours of drawing-room and laboratory practice are devoted to plane surveying, contour plotting, cut and fill calculations, setting of batter boards, alignments of shafting and the study from blue-prints of slow-burning construction. [Course VI, Options G, C, W.]

Mill Engineering—B-34a. Preparation: B-21. Mill Engineering, as presented in thirty lectures during the third year of the diploma courses, is largely general in its nature and includes only parts of Course B-34. [Courses I, II.]

Principles of Marketing—B-35. An introduction to the basic principles underlying the modern systems of distributing goods with special emphasis on the raw and finished products of the textile industry. The course will cover the history and economic importance and functions in modern distribution of the selling agent, the commission man, the broker, jobber, merchant, factor and other intermediaries as well as the channels that goods may take from the producer to the ultimate consumer. The importance and advantages of each will be studied with special emphasis on the present practice and trends in the textile industry.

Lectures and the case method of instruction will be employed. [Course VI, Sales Option.]

Marketing Methods—B-36. Preparation: B-35. A continuation of the Principles of Marketing. The course will be conducted by means of lectures and case problems and discussions. Some of the subjects studied in detail are,—the planning of marketing campaigns, the fluctuations of price and style, forecasting, the business cycle, quotas, market surveys and research, sales planning and control, industrial marketing, and consumer merchandising.

Considerable time will be devoted to the study of current literature and events in the textile field. [Course VI, Sales Option.]

Textile Physics—B-37. Preparation: B-23. The work in this subject consists of experimental determinations of the physical properties of textile fibers, yarns and fabrics. Special emphasis is placed upon the study of properties which determine the color characteristics of textile materials. [Course VI, Design and Sales Options.]

Accounting—B-40. Preparation: B-10 and E-30. The purpose of the course in accounting is to acquaint the student with modern methods of accounting for mercantile and manufacturing businesses. At the same time it gives him a much-needed knowledge of such common elementary business transactions as are involved in the use of checks, drafts, notes, vouchers, bonds and stocks.

It is not the purpose of the course to make the student a proficient bookkeeper or accountant, but the nature of the work necessitates a basic knowledge of double-entry bookkeeping and of the functions of ledger accounts. This is developed in practice in the following manner: During the summer preceding the fourth year the student is required to work up a simple bookkeeping set, thus saving valuable time during the school year and effectively preparing the ground for the instruction work.

The course includes a study of the balance sheet and profit and loss statement, and their construction in proper form Attention is given to the principles of balance sheet valuation, and to such topics as depreciation, sinking fund reserves and the accounting for bond and stock issues.

One-half of the time scheduled for accounting is devoted to a study of Cost Accounting. It is designed to give the student a knowledge of the best cost methods in use at the present time, and involves a thorough discussion of methods of handling and accounting for raw materials, direct labor, the distribution of overhead expenses and the predetermination of costs. [Course VI.]

Microscopy—B-41. Preparation: B-23. This subject consists of the study of animal and vegetable fibres by means of the microscope and its accessories. It includes sectioning and mounting, measurements of diameter and twist, and the use of polarized light in the study and identification of fibers. [Course VI.]

Textile Marketing—B-42. This subject covers the problems of marketing textile products, with particular emphasis upon the ultimate consumer. The course will survey the principal marketing channels and marketing methods. Attention is directed to the possibilities of demand creation and demand control, especially through market and style research. Current changes in marketing organization of the industry will be studied and reviewed. [Courses IV and VI. Options G, C, W, D.]

Textile Testing—B-43. Preparation: B-23, F-30 or G-30, D-32. This course is planned to familiarize the student with the latest methods and devices for determining the physical properties and characteristics of textile fibers, yarns and fabrics. The scope of the work is indicated by the following topics: abrasion, absorptability, atmospheric control, bursting, crimp, heat transmission, porosity, regain, resilience, stretch, tear, tensile strength, thickness, twist, waterproofness, precision of measurements, interpretation and presentation of data. These are treated both from the standpoint of commercial testing and of textile research. |Course VI.|

Electrical Engineering—B-44. Preparation: B-31. During the first term a detailed study of the alternator is made, with particular stress on generation of three-phase currents. Methods of predetermination of alternator regulation are taken up and at least one method compared with laboratory test. Parallel operation of alternators with acccompanying instruments and devices are studied in classroom and laboratory. The single phase, three-phase and Scott transformers are considered in turn and their various methods of connecting to line and alternators are systematically studied.

In the second term the induction motor and generator are studied with their particular adaptability to the textile industry. The principal starting devices for this motor are thoroughly taken up. The synchronous motor is studied particularly in relation to its ability to correct power factor. In all the work outlined above, the main features are illustrated profusely in classroom demonstrations and laboratory exercises. [Course VI, Options G, C, W.]

Mill Engineering—B-45. Preparation: B-34. This work, given in the fourth year of the Textile Engineering course, covers a wide range of subjects and is of the most practical character possible. All of the student's previous work in engineering and his knowledge of the textile processes are here brought together in the consideration of the larger problems of mill design, construction and organization. After a detailed study has been made of the most modern types of mill buildings, including all calculations and drawings, the student is given the problem of laying out and completely designing a textile mill so far as time permits.

The modern methods of power transmission and the proper arrangement of textile machinery are also given careful consideration. The problems are in every case taken from actual conditions in mills already built or in process of construction. The questions of mill heating, ventilation, lighting, humidification and fire protection are also studied and the time spent in the drawing room enables the student to work out nearly all of the more important problems involved in the design of an entire textile mill plant. The close relation existing between proper plant design and economical production is also considered. [Course VI, Options G, C, W.]

Business Administration—B-46. Preparation: B-10 and E-30. In recognition of the great advances which have been made recently towards better methods of management, and of the possibilities which may result from its application to the textile industry, a course in business administration has been established to enable the student to understand and apply the principles and details of modern management. The instruction in this course begins with a consideration of the factory location and design and their effect on efficiency of production, after which the proper form of organization for manufacturing establishments is discussed in detail, together with organization charts and records.

This is followed by a study of the details of the work of the various departments, such as purchasing, manufacturing, planning, etc. and includes such topics as purchasing systems, storekeeping, perpetual inventories, warehousing, scheduling, routing, tracing, timekeeping, motion studies, time studies, mnemonic symbolizing, graphical records, wage systems, etc. Consideration is also given to the important relation of psychology to efficient management.

Business Law. Under this subject are given lectures, supplemented by the use of a suitable text, on the law governing contracts, negotiable instruments, sales, bills of lading, real estate and corporation. [Course VI.]

Mill Illumination—B-47. Preparation: B-23. Because of the demand and the necessity for proper lighting of textile mills, this course is offered three hours per week for one term. It consists of three major parts,—photometry, illumination and installation design. Costs and estimates, safety and production are included.

The laboratory exercises include the study and applications of the photometer, Macbeth Illuminometer and foot-candle meter. The concluding work is a design of a lighting installation for a typical mill room, using the school laboratories for this purpose. [Course VI, Options G, C, W.]

Electives—B-48. Students in the fourth year of the Textile Engineering course will be permitted to elect certain textile subjects as substitutes for part of the time scheduled for engineering subjects. Thus a student is offered an opportunity for specialized study along such lines as will prove most beneficial to him at that time. The selection of elective studies is subject to the approval of the head of the Textile Engineering department and to the possibility of arranging for the same. [Course VI, Options, G, C, W.]

Principles of Selling and Advertising—B-49. A comprehensive course dealing with the fundamental principles of advertising and selling. The course will cover the psychology of selling and advertising, the legal restrictions in marketing, advertising technique, copy writing, layout, illustrations, advertising campaigns, packaging, advertising mediums, industrial and consumer advertising, creative salesmanship, personality, types of customers, the selling process, supersalesmanship, etc.

Lectures and the case method of instruction will be used. [Course VI, Sales Option.]

Textile Styling—B-50. This course will correlate the technical knowledge of design, acquired previously, to the fluctuations of style design, the creation of fads and the forecasting and planning of styles. [Course VI, Options D, S.]

Foreign Trade and Economic Geography—B-51. The course will cover the foreign markets for finished textiles and the American raw fibers, methods of selling employed, foreign commercial law that an American exporter needs, the foreign fibers and textiles and their importance in international trade.

Special emphasis will be given upon costs of foreign marketing, tariffs, international competition, possible markets and methods of building an export business. [Course VI, Sales Option.]

Selling Policies—B-52. This course will cover the development of administrative policies and guiding principles in the marketing, pricing, styling and merchandising of textiles and textile fibers. [Course VI, Sales Option.]

Statistics—B-53. A study of elementary statistics which relate to industry, trade and general business and financial conditions. It includes the analysis, presentation and interpretation of statistical data, index numbers, correlation, law of error, cyclical fluctuations, dispersion, trend and other pertinent topics. [Course VI, Sales Option.]

CHEMISTRY AND DYEING DEPARTMENT—C

Elementary Chemistry (Inorganic and Organic Chemistry)—C–10. Preparation: Admission Requirements. Instruction in Inorganic Chemistry extends through the first year, and includes lectures, recitations and laboratory work. The subject of Organic Chemistry is covered by lectures during the second term.

Inorganic Chemistry

Non-Metallic Elements.—Their occurrence, properties, preparation, chemical compounds, etc.

Metallic Elements.—Their occurrence, properties, metallurgy, chemical compounds, etc.

Theoretical Chemistry.—Fundamental laws and the theories of chemistry including chemical action, chemical combination, combining weights, atomic weights, chemical equations, acids, bases, salts, Avogadro's law, molecular weights, formulæ, valence, periodic law, etc.

Throughout this course special attention is given to the relationship which exists between the science of chemistry and the properties of the materials used in the various industries and the chemical reactions depended upon for the maintenance of industrial processes.

The laboratory work of this course includes the experimental study of the above subjects and also a preliminary study of the qualitative detection of the more common metals and non-metals, preparatory to Course C–11. Students with sufficient preparation are allowed to substitute preliminary work in qualitative analysis for the laboratory work in general chemistry, thus increasing the scope of their second term course in qualitative analysis.

Organic Chemistry

This course includes a general survey of the fundamental principles of Organic Chemistry, also a study of the hydrocarbons and their derivatives from the point of view of their structure, preparation and uses. This work, although elementary in character, is of sufficient breadth to prepare the student understandingly for the general lectures upon coal tar dyestuffs which are given in Course C–20. [All courses.]

Qualitative Analysis—C–11. Preparation: C–10, taken simultaneously. Qualitative Analysis is studied during the second term of the first year, the regular class periods being supplemented by extra hours noted under C–10. It consists chiefly of laboratory work, with individual instruction, on the properties and identification of inorganic substances. The student must become familiar with the separations and the detections of the common metals and acids by the analysis of a satisfactory number of solutions, salts, alloys and pigments. At intervals during the term short laboratory tests are given as well as the regular written examinations.

When sufficiently advanced, students take up the examination of various products with which the textile chemist must be familiar such as testing mordanted cloths, pigments and the various dyeing reagents.

During the latter part of this course a certain amount of time is devoted to the preliminary operations of quantitative analysis, such as the precipitation and washing of such substances as barium sulphate, magnesium ammonium phosphate and calcium oxalate, although no weighings or actual determinations are made. [Course IV.]

Textile Chemistry and Dyeing—C–20. Preparation: C–10, B–12, B–14. The outline of the lecture course which is given during the second year is as follows:—

Technology of Vegetable Fibers.—Cotton, linen, jute, hemp, china grass. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Animal Fibers.—Wool, mohair, silk. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Artificial Fibers.—Study of the various forms of artificial silk, the process of manufacture, their properties and action with chemicals, acids and heat.

Operations Preliminary to Dyeing.—Bleaching of cotton and linen; wool-scouring; bleaching, fulling and felting of wool; carbonizing; silk-scouring and bleaching; action of soap.

The bleaching of cotton cloth, yarn and raw stock is studied at length with detailed description of the various forms of kiers and machinery used; also the action of the chemicals used upon the material, and the various precautions that must be taken in order to insure successful work.

Under this heading is also included an exhaustive study of the reagents used in the emulsive wool-scouring process, and their action upon the fiber under various conditions; also the most successful of the solvent methods for degreasing wool.

Water and its Application in the Textile Industry.—Impurities present, methods for detection, their effect during the different operations of bleaching, scouring, dyeing and printing and the methods used for their removal or correction.

The important subject of boiler waters is also studied under this heading, with a full discussion of the formation of boiler scale, its disastrous results, and the methods by which it may be prevented.

Mordants and Other Chemical Compounds Used in Textile Coloring and Classified as Dyestuffs.—Theory of mordants, their chemical properties and application, aluminum mordants, iron mordants, tin mordants, chromium mordants, organic mordants, tannin materials, soluble oil, fixing agents, leveling agents, assistants, and numerous other compounds, not dyestuffs, that are extensively used in the textile industry.

Under this heading are included the definitions of various terms and classes of compounds used by textile colorists, such as color lakes, pigments, fixing agents, developing agents, mordanting assistants, mordanting principles and leveling agents.

Theory of Dyeing.—A discussion of the chemical, mechanical, solution and absorption theories, and the various views that have been advanced by different investigators of the chemistry and physics of textile coloring processes.

Under this heading are discussed the general methods of classifying dyestuffs and the definitions of such terms as textile coloring, dyeing, textile printing, substantive and adjective dyestuffs, monogenetic and polygenetic dyestuffs.

Natural Organic Coloring Matters.—Properties and application of indigo, logwood, catechu or cutch, Brazil wood, cochineal, fustic, turmeric, madder, quercitron bark, Persian berries, and other natural dyestuffs that have been used within recent years by textile colorists.

Mineral Coloring Matters.—Under this heading are discussed the properties of such inorganic coloring matters and pigments as chrome yellow, orange and green, Prussian blue, manganese brown and iron buff.

Artificial Coloring Matters.—General discussion of their history, nature, source, methods of manufacture, methods of classification and their application to all fibers.

Special study of basic coloring matters, phthalic anhydride colors, including the eosins and phloxines; acid dyestuffs, Janus, direct cotton, sulphur and mordant colors, including the alizarines and other artificial coloring matter requiring metallic mordants; mordant acid and insoluble azo colors, developed on the fiber; reduction vat colors, aniline black and other artificial dyestuffs not coming under the above heads.

As each class of dyestuffs is taken up, the details of the methods of applying them upon all the different classes of fabrics and in all the different forms of dyeing machines are thoroughly discussed; also the difficulties which may arise in their application, and the methods adopted for overcoming them.

Machinery Used in Dyeing.—A certain amount of time is devoted to the description of the machinery used in various processes of textile coloring which is supplemented as far as possible by the use of charts, diagrams and lantern slides.

Most of the important types of dyeing machines are installed within the dyehouse of the school, and the students can be taken directly from the lecture room and shown the machines in actual operation. [All courses.]

Dyeing Laboratory—C-21. Preparation: C-20 taken simultaneously. Besides lectures and recitations upon the subject of Textile Chemistry and Dyeing, practical laboratory work is required. By the performance of careful and systematic experiments the student learns the nature of the various classes of dyestuffs and their coloring properties, their action under various circumstances, and the conditions under which they give the best results. The more representative dyestuffs of each class are applied to cotton, wool, silk and the various types of rayon, and each student is obliged to enter, in an especially arranged sample book, a specimen of each of his dye trials with full particulars as to the conditions of experiment, percentage of compounds used, time, temperature of dye bath, etc.

For convenience and economy most of the dye trials are made upon small skeins or swatches of the required materials, but from time to time students are required to dye larger quantities in the full-sized dyeing machines which are described elsewhere.

By the use of a small printing machine the principles of calico printing are illustrated, and by means of the full-sized dyeing machines and vats the practical side of the subject is studied. It is the constant endeavor of those in charge to impart information of a theoretical and scientific character that will be of value in the operation of a dyehouse. [Course IV.]

Advanced Organic Chemistry—C-22. Preparation: C-10. In this course, which consists of lectures and recitations, the principles of organic substitution and synthesis are thoroughly discussed and as many illustrations are used as time will permit, particularly such as are applied in the arts. The aliphatic series of hydrocarbons and their derivatives are studied for about twenty weeks, the remainder of the time being devoted to the benzine series. The aim of the course is to lay a broad foundation for the study of the chemistry of the artificial dyestuffs. Students are required to work out problems in the synthesis of various compounds, in order to become familiarized with equation writing. [Course IV.]

Quantitative Analysis—C-23. Preparation: C-11. The object of this course is to teach the fundamental principles of quantitative analysis, and to give the student an opportunity of acquiring skill in manipulating the special apparatus used in analytical procedure.

Typical gravimetric methods are taught the first term. The samples analyzed comprise salts, minerals and ores. Electrochemical analysis is carried out with the aid of a modern type of apparatus designed for rapid work.

The work of the second term consists of volumetric methods. A number of ores and commercial products, carefully chosen, are analyzed so as to give the student a varied experience.

The laboratory work is supplemented by lectures and recitations. Smith's "Quantitative Chemical Analysis" is used as a text. [Course IV.]

Stoichiometry—C-24. Preparation: B-10, C-10. This subject is taken one hour each week during the second year. The application of the metric system is thoroughly studied, and problems are worked involving the expansion and contraction of gases, determination of empirical formulae, combining volume of gases and chemical calculations, especially those of quantitative analysis. [Course IV.]

Quantitative Analysis—C-30. Preparation: C-23. The fundamental principles acquired in Course C-23 are applied in this course in the examination of materials used in the textile mill, the dyehouse, and the finishing plant. Among the materials analyzed are water, soaps, oils, textile fabrics, stripping agents, acids and alkalies. The latest and most practical methods are employed. Griffin's "Methods of Technical Analysis" is used as a text. [Course IV.]

Industrial Chemistry (Lecture)—C-31. Preparation: C-22. During the second term of the third year lectures and recitations are held in industrial chemistry, the course in general following Riegel's "Manual of Industrial Chemistry." Particular attention is paid to those subjects which are of special interest to the

textile chemist, as oils, soaps, gas and coal-tar industry, building materials, and the manufacture on a large scale of important chemical compounds, such as the common acids and alkalies, bleaching powders, various mordants, etc. The course is illustrated as far as possible with specimens, diagrams, and charts, and the students are given an opportunity to visit some of the industrial establishments in the vicinity of Lowell and Boston. [Course IV.]

Advanced Textile Chemistry and Dyeing—C-32. Preparation: C-20, C-21. This is a continuation of the Textile Chemistry and Dyeing course of the second year, and includes a review of the second year's work in this subject, with the introduction of many advanced considerations, and in addition, the following subjects:—

Classification and Construction of Artificial Dyestuffs.—A study from a more advanced standpoint of the classification and constitution of artificial dyestuffs including the various methods used in their production, also the orientation of the various groups which are characteristic of these compounds and their effect on the tinctorial power of dyestuffs.

The object of this study is to give the student a more complete knowledge of the artificial dyestuffs from the color manufacturer's point of view, which will prove of particular value to those who intend later to enter the employ of dyestuff manufacturers or dealers.

Color Matching and Color Combining.—A study of that portion of physics which deals with color and the many color phenomena of interest to the textile colorist. The lecture work is supplemented with the practical application of the spectroscope and tintometer, and much practice in the matching of dyed samples of textile material.

The primary colors both of the scientist and textile colorist, the results of combining coloring lights and pigments, and such subjects as color perception, color contrast, purity of color, luminosity, hue, color blindness, dichroism, fluorescence and the effect of different kinds upon dyed fabrics, are discussed under this heading.

Each student's eyes are tested for color blindness early in the course, in order that he may be given an opportunity to change his course if his eyes should prove defective enough to interfere with his work as a textile colorist.

A dark room has been provided where various experiments in color work and color matching may be performed.

Dye Testing.—This subject includes the testing of several dyestuffs of each class, subjecting them to the common, color-destroying agencies; the determining of their characteristic properties, and their action towards the different fibers; also the determining of the actual money value and coloring power of dyestuffs in terms of a known standard.

Each student is required to make a record of each color tested upon an especially prepared card, which furnishes a permanent record of all dyestuffs, their dyeing properties, fastness to light and weather, washing, soaping, fulling, perspiration, bleaching, steaming, ironing, rubbing, acids and alkalies.

Union Dyeing.—A study of the principles involved in the dyeing of cotton and wool, cotton and silk, and silk and wool union materials in the production of solid and two-color effects.

Textile Printing.—A thorough study of the whole subject of textile printing, each student being required to produce individually no less than twenty different prints, including the following styles; pigment style, direct printing style, steam style with tannin mordant, steam style with metallic mordant, madder or dyed style, the ingrain or developed azo style, discharge dye style, discharge mordanted style, resist style, indigo printing, aniline black printing.

The different parts of the calico printing machine are thoroughly studied; also the precautions which must be considered in its use, and the arrangement of the dyeing apparatus which must accompany such a machine.

Special attention is paid to the methods of mixing and preparing the various color printing pastes that are used in the above work upon a manufacturing scale as well as experimentally in the laboratory.

Cotton Finishing.—A study of the various processes of finishing cotton cloth and the different materials used therein. The work involves the discussion

of the various objects of cotton finishing and such operations as pasting, damping, calendering, stretching, stiffening, mercerizing, beetling and filling, and the various machines used for carrying out these processes.

Mill Visits.—During the third and fourth years visits are made to some of the large dyehouses, bleacheries and print works in the vicinity. [Course IV.]

Physical Chemistry—C-33. Preparation: B-20a, B-22a, C-10. During the third year, three hours per week of lectures and recitations are given on the application of the experimental methods and calculations of physics to chemical phenomena. Students passing this course may supplement it by the optional laboratory course C-42 in the fourth year. [Course IV.]

Advanced Organic Chemistry—C-34. Preparation: C-22. This is a continuation of Advanced Organic Chemistry C-22. [Course IV.]

Technical German—C-35. Preparation: C-20, C-22, E-21. This course consists of the reading of German technical literature with the object of familiarizing the student with the current German publications in textile chemistry and coloring. [Course IV.]

Organic Chemistry Laboratory—C-36. Preparation: C-20, C-22, C-23. This course, while including practice in the usual methods of organic analysis, and giving excellent training in the principles and manipulations of general organic synthesis, is especially devoted to the synthetic dyestuffs. The student not only prepares many of the representative dyestuffs, but, what is far more important, he carries out all the operations, beginning with coal tar itself. Thus, instead of merely coupling two or more of the foreign imported intermediate products to make a dyestuff, he starts with the basic substances obtained from the coal tar and makes his own intermediate products. As far as is possible the student will be made acquainted with the problems which might arise in a dyestuff factory, and an excellent opportunity is presented for original work. [Course IV.]

Photography—C-37. Preparation: B-23, C-20, C-22, C-23. Photography is today indispensable to the scientist and textile chemist. Without the aid of photography he cannot preserve and keep an absolute and accurate record of his investigations and research problems.

The Institute therefore offers to the Senior Chemists an eight-weeks course in the elements of Photography. One object of this course is to provide the student with the preliminary knowledge and training necessary for the course in Microscopy and Photomicrography which follows.

The course includes a study of the different types of cameras and lenses, the making of contact prints from classified negatives using various grades of papers, reduction and intensification of negatives, enlarging, copying, negative making and lantern slide preparation.

The theory and chemistry of the above subjects are not only covered in the classroom but in addition all of this work is actually carried on by each individual student in the Photographic Laboratory and Dark Room. [Course IV.]

Technical German—C-40. Preparation: C-35. This is a continuation of Technical German C-35. [Course IV.]

Organic Chemistry Laboratory—C-41. Preparation: C-34. This is a continuation of Organic Chemistry Laboratory C-34. [Course IV.]

Industrial Chemistry—C-42. Preparation: C-31. This is a continuation of Industrial Chemistry C-31. [Course IV.]

Chemical Textile Testing—C-43. Preparation: C-21, C-32. A series of lecture and laboratory periods covering the theory and use of the instruments and apparatus used in testing and evaluating textile materials. Emphasis is given to those tests which may be used to give a chemist valuable information as to the source and quality of textiles. The last part of the work consists of chemical and optical tests which may be necessary to a textile chemist in either routine or research work. [Course IV.]

Advanced Textile Chemistry and Dyeing—C-44. Preparation: C-32. This is a continuation of the third-year work in Advanced Textile Chemistry and Dyeing, and includes the following subjects:—

Advanced Organic Chemistry (Dyestuffs). Advanced study of the coal-tar coloring matters, their chemistry, relations of their compositions to their coloring power, and the chemistry of their preparation.

Economics of the Dyeing, Bleaching and Finishing Industries.—A study of the factors to be considered in the establishment of a dyeing, bleaching and finishing plant together with the most essential considerations of its management.

Advanced Dyeing Conference.—During the latter part of his course each student will be required to write, for presentation before the other members of his class, a paper upon some assigned subject of general interest. After presentation the subject will be open to discussion and question.

The object of this conference is twofold. First, to give the student experience and practice in systematically looking up an assigned subject and presenting it before others; and secondly, to bring before the class a greater variety of subjects with more detail than could be covered by the general lectures of the course. [Course IV.]

Microscopy and Photomicroscopy—C–45. Preparation: B–23, C–20, C–22, C–37. The value of the microscope in the identification of textile materials and the examination of textile yarns and fabrics cannot be overestimated. In conjunction with photomicroscopy a permanent record which may be filed for future reference and which is understandable by non-technical men is obtained.

In this course the students are given instruction in the use and construction of various types of microscopes and accessories; the preparation and mounting of samples; the identification of starches and fibers; microchemical reactions; and examination of fabrics for faults. Actual unknown fibers, starches and fabrics are examined and reported upon.

Following microscopy, the student takes up photomicroscopy, for which he has been prepared by a thorough course in the common processes of photography. The types and constructions of photomicrographic apparatus, adjustments, and exposures are taught by actual work in the photomicrographic laboratory. The student studies the use of such auxiliaries as color filters, polarized light, dark-ground illumination, color photography, and works at both high and low magnifications. At the end of the course the student is given a typical industrial or research problem on which he works independently and upon which he must prepare a complete report, illustrated by appropriate photomicrographs. [Course IV.]

Quantitative Analysis—C–46. Preparation: C–30. This course consists of lectures, recitations and quizzes on the fundamental principles of analytical chemistry. [Course IV.]

Report Writing—C–47. Preparation: B–20a, E–20. The purpose of this course is to enable the student to write a technical report clearly. An analysis of a complete research is first made. This is followed by a bibliography and instructions in the use of reference books and technical journals. Methods of obtaining and interpreting laboratory data are given and the elements of statistical analysis demonstrated and used. Instruction and illustrations of various technical and non-technical, formal and informal, laboratory and plant reports are given. [Course IV.]

Textile Literature—C–48. Preparation: C–47. The object of this course is to introduce the student to the current sources of information on textile chemical subjects. Each student is assigned a subject and is required to keep informed on that subject by first a survey of the literature and then the reading of current technical journals. Reports are tendered informally and orally. [Course IV.]

Advanced General Chemistry—C–49. Preparation: C–10, C–11, C–24, C–34, C–42, C–46. The object of this course is more to correlate the various branches of chemistry studied in the previous three and one-half years than to introduce new material. An attempt is made to show the essential oneness of all chemical knowledge. Recent theories are discussed briefly. [Course IV.]

Engineering Chemistry—C–50. Preparation: C–22, C–23. This course consists of a series of lectures covering the derivation, sampling, analysis, and specification of coals, gasolines, kerosenes, fuel gases, flue gases, oils, greases, and boiler waters. This is followed by a study of combustion and the underlying principles of lubrication. The lectures are supplemented by laboratory work consisting of complete analyses of coal, gasoline, oil, grease, flue gas, and illuminating gas. [Course IV.]

The Chemistry of Rayon, Its Manufacture, Bleaching, Dyeing and Finishing—C–51. Preparation: C–32. During the past five years the develop-

ments of the bleaching, dyeing and finishing of rayon have been systematically studied and the curriculum of the Chemistry and Textile Coloring course has been revised from time to time to cover the latest developments in regard to these fibers. There is being installed at the present time a complete unit for the actual manufacture of rayon, and with this available for experimental and demonstration purposes, it is anticipated that during the coming year instruction upon the production and subsequent treatment of rayon will be greatly amplified.

Many of the difficulties which arose during the early days of the artificial silk industry were due to lack of knowledge of its properties and more or less persistent attempts to handle it in just the same manner as real silk. As soon as the textile manufacturer began to fully appreciate the fact that the various rayons were entirely different fibers from true silk and consequently must be handled by different methods, then many extensive improvements were made in the processes of manufacturing textiles containing these fibers. In order to satisfactorily handle the different rayons they must receive a preliminary treatment with various oils and softeners, and as a result the problem of establishing the specifications for the best type of oil to use for this purpose and also the best methods of removing it from the material during the finishing process have been important problems in the development of the industry, and these among others are being studied in the Lowell Textile Institute at the present time. [Course IV.]

Optional Subjects or Thesis during fourth year—C-52. Preparation: Satisfactory completion of all first and second year subjects in Course IV. The value of undergraduate thesis work for all students has frequently been questioned. There is no doubt that many senior students might take optional work of an advanced nature to greater advantage than devoting the same amount of time to specific thesis work. With this in mind beginning 1931-32 several options were introduced, each optional period being 45 hours per term and four of these being required during the year.

If a student has indicated through the first three years of his work that he is capable of handling an original investigation, a definite thesis subject may be assigned to him which will require the entire 180 hours. At the discretion of the Head of the Department, thesis subjects involving one or more option periods may also be assigned.

In all cases, however, 180 hours' work of an advanced nature, either of thesis work or optional subjects, will be required for graduation.

Options: Textile Chemistry Laboratory. A laboratory course on some branch of textile chemistry varying from year to year.

Photomicroscopy. A series of laboratory experiments followed by a research problem in photomicroscopy. Effects of the optical system, exposure, polarized light and dark ground illumination are studied and color photomicroscopy is included as far as time permits.

Colloid Chemistry. A seminar course on general colloid chemistry with special applications to textiles. The colloid chemistry of dyeing, the action of detergents, and the swelling effects of various materials on the fibers are especially emphasized.

Microbiology I. This course gives a general survey of the effect of the various micro-organisms on textile materials. Consideration is given to the methods of studying molds and bacteria and the methods of preventing their growth on textiles. In the laboratory the solution, identification and properties of the organisms are studied. The detection of micro-organisms on fibers and damage to fibers caused by their growth is studied in detail. Methods of testing antiseptics to be used on textiles are also studied.

Microbiology II. A continuation of Microbiology I, laying special emphasis on the branch of microbiology in which the student is most interested. No lectures are given but each student is required to do certain reading and frequent conferences are held with the instructor. In the laboratory each student selects some problem and works it out as thoroughly as time permits.

Rayon. Laboratory practice in manufacture of viscose rayon.

Physical Chemistry. Measurement of molecular weights, heats of reaction, vapor pressure, surface tension, hydrogen ion concentration, electrical conducttivity, etc.

TEXTILE DESIGN AND WEAVING DEPARTMENT—D

Textile Design and Cloth Analysis—D-10. During the first year instruction is given in the subject of classification of fabrics, use of point or design paper, plain fabrics, intersection, twills and their derivation, sateen, basket and rib weaves, checks and stripes, fancy weaves, including figured and colored effects; producing chain and draw from design, and *vice versa;* extending and extracting weaves.

This subject takes up in a systematic manner the analysis of samples illustrating the various cloth constructions for the purpose of determining the design of the weave and the amount and kind of yarns used, and forms the basis of calculation in the cost of reproducing any style of goods. The various topics discussed are reeds and setts; relation and determination of counts of cotton, woolen, worsted, silk and yarns made from the great variety of vegetable fibers; grading of yarns, folded, ply, novelty and fancy yarns; application of the metric system to yarn calculation; problems involving take-up, average counts, determination of counts of yarn, and weight of yarn required to produce a given fabric. [First term, all courses.] [Second term, Courses I, II, III, VI.]

Textile Design and Cloth Construction—D-20. For Cotton Goods—Preparation: D-10. During the second year consideration is given to fancy and reverse twills, diaper work, damasks, skip weaves, sateen fabrics with plain ground, backed fabrics, and multiple ply fabrics. Students are required to make original designs and put the same into the loom. Special attention is given to the consideration of color effect.

During the first term free-hand drawing is taught by means of plates, and practice in coloring is given in conjunction with this work.

Practice in lettering, spacing and general arrangement of designs and sketches is given. The engineering alphabet is used in all work.

During the second term instruction is given in drawing, sketching, coloring and designing, with reference to their application in textiles. Good examples of applied design in textiles, as well as in other branches, are used as a basis for modified designs selected and composed by the student. This stimulates originality as well as teaches the student to appreciate good designs and color.

The analysis of these fabrics forms a part of the course in design. This also includes the necessary calculations required to reproduce the fabric or to construct fabrics of similar character. [Courses I, III, VI, Options C, D, S.]

Textile Design and Cloth Construction—D-21. For Woolen and Worsted Goods—Preparation: D-10. During the second year the instruction given includes warp and filling backed cloth, figured effects produced by extra warp and filling, double cloths, multiple ply fabrics, cotton warps, blankets, bathrobes, crepes, filling reversible, Bedford cords, imitation furs, crepons, matelasse and imitations, double plain, ingrains, velvets, corduroys, overcoatings, trouserings.

The analysis of these fabrics, together with the consideration of the shrinkages and dead loss in all fabrics, theory of diameter of yarns, and costs of blends and mixes is a part of this course. [Courses II, III, VI, W, D, S.]

Textile Design and Cloth Construction—D-22. Preparation: D-10. This is a short course covering the elementary principles of designing in general. Instruction is given in the theory of shrinkages and the lay-out of woolen and worsted fabrics, and at the same time similar instruction is given in the design and construction of cotton fabrics. [Course VI, General Option.]

Jacquard Design—D-23. Preparation: D-10. This course, given during the second term, covers detail instruction of the Jacquard machine and the various tie-ups in common use, the layout for different kinds of fabrics, and the cutting of cards in accordance with prepared designs. The adaptation of various designs to woven fabrics through the aid of cross section paper and its correlation with the different types of looms and Jacquard machines are thoroughly covered. The student is encouraged in original designs and such of these as meet approval are carried out in woven goods. [Course III.]

Power Weaving—D-24. Preparation: D-10. In connection with the work in Textile Design and Cloth Analysis practical work is carried on upon the power looms. This includes the preparation of warps, beaming, dressing, sizing, draw-

ing-in and making of chains, the cutting and lacing of cards, spooling and quilling and the machinery for the same. A study is made of warpers and sizing machines, both for cotton and woolen. Lectures are given to correspond with the progress of the student in the Power Weaving Laboratory covering the following subjects: loom adjustments, chain building, shuttle changing looms, dobby looms, single and double acting dobbies, handkerchief motions, leno weaving, center selvedge motion, filling changing looms, oscillating reeds, lappet motions, various shaker motions, towel and other pile cloth weaving, Jacquard looms, single and double lift leno Jacquards, Jacquards of special design, tying up Jacquard harness. [Courses I, II, III, VI.]

Textile Design and Cloth Construction—D–30. Preparation: D–20 or D–21. The advanced work takes up the more complicated weaves adapted to harness work, and leads into leno and Jacquard designs. The following is a brief list of the subject heads, which will give some idea of the course: double plain cloths, ingrains, tricots, chinchilla, tapestry, blankets, upholsteries, spot weaves, pile or plush, crepon, matelasse and its imitations, pique, Marseilles, quilting, and miscellaneous designs for Jacquard, leno, fustian, tissue fabrics and lappets.

Original designs and sketches for particular grades of goods and the study of color effects form an important part of the third-year course. It should be understood that work in decorative art is carried on in conjunction with textile construction and weaving, particularly on the Jacquard loom. Designs of merit are carefully developed in detail and woven into cloth.

The work in cloth construction includes the application of the different weaves and their combinations in the productions of fancy designs, both modified and original; the calculation involved in the reproduction of standard fabrics changed to meet varying conditions of weight, stock, counts of yarn and value; and the discussion of the breaking strength of fabrics and relationship of the construction of the fabric to breaking strength.

Instruction in this subject, which is given by classroom work, is intended to bring together the principles considered under the subject of design, cloth construction, weaving and yarn making of previous years, and to show the bearing each has in the successful construction of a fabric. [Courses III, VI, Options C, D, S.]

Jacquard Design—D–31. This is a continuation of Jacquard Design D–23. [Course III.]

Power Weaving—D–32. Preparation: D–20, D–21, or D–23. Instruction is given in weaving on fancy woolen and worsted looms, single and double acting dobbies, leno weaving, various shaker motions, lappet loom weaving, double and single lift Jacquard looms, tying up Jacquard harness, leno Jacquard, harness and box chain building; warp preparation for woolen and worsted and cotton; formulas for making up different kinds of sizing. Lectures are given to correspond with the same. [Courses I, II, III, VI.]

Jacquard Design and Weaving—D–40. Preparation: D–23. Instruction bears particular stress on the sketching of original designs as applied to particular fabrics with reference to the more advanced forms of fabrics and warp tie-ups. In this work the student not only produces his own sketches but must carry his ideas through to the finished fabric. [Course VI, Options D, S.]

Textile Design and Cloth Construction—D–41. Preparation: D–10, D–20, D–21. The work in this course is the application of the instruction received during the three years previous. Particular attention is given to the layout of designers' blankets. Instruction in the production of new designs is given by the use of design suggestion sheets. As in the Jacquard work the student must not only lay out the blankets but must put them in the loom and work out the various effects for himself. [Course VI, Options D, S.]

Decorative Art for Special Students. This course is planned to give a student a working knowledge and appreciation of design. The first and second years are devoted to a general study of design, color, perspective, lettering and rendering. Drawings are made in the historic styles for all materials,—wood, gold, silver, copper, brass, leather, fabrics, wall papers and glass.

In the third year students should specialize and devote their attention to the material in which they expect to work.

LANGUAGE AND HISTORY DEPARTMENT—E

English—E-10. Preparation: Admission Requirements. A technically trained man should be able to express himself clearly, forcibly and fluently, as inability to do so will be a serious handicap to him in after life. The object of the English course is to develop the student's power of expression by a thorough study of the principles of advanced rhetoric and composition, and by constant writing of themes illustrative of the four forms of discourse, viz., description, narration, exposition and argumentation. In addition to the study of rhetoric and composition and the writing of themes, several classics such as are not read in the preparatory schools are studied and discussed. [All courses.]

Elementary German—E-11. Preparation: Admission Requirements. This course is intended for first-year students who do not offer German as an entrance requirement and who desire to take the course in Chemistry and Textile Coloring. It may be selected by students taking the Textile Engineering course who have not fully met the entrance requirements in language. The work is elementary in character, and much time is devoted to the study of the rudiments of German grammar with practice in composition. During the latter part of the year considerable attention is given to the reading of ordinary German prose, which serves as an additional preparation to the student for the later reading of works along scientific and industrial lines. [Course IV.]

English—E-20. Preparation: E-10. The curriculum of this course is based upon the sound belief that the young man about to enter business can profit much by the study of the principles and the rules of standard English as applied to business writing. The student is given a comprehensive remedial review of the fundamentals of grammar in their relation to practical expression in writing letters and reports. Class discussions of actual quoted letters, collateral readings, and home preparation of written assignments afford the student abundant opportunity to enlarge his vocabulary and to improve his style. During the second semester, modern essays and other works of fiction are read and discussed. The course meets twice each week. [Course IV.]

Advanced German—E-21. Preparation: E-11. For students taking the course in Chemistry and Textile Coloring the elementary course of the first year is continued throughout the second year. The work consists of the study of some of the more advanced principles of grammar, and especially of the reading of scientific German, dealing with a variety of subjects, and the translation of commercial German. [Course IV.]

Economics—E-30. Preparation: E-10. This course, meeting three times a week, is conducted by means of lectures, discussions, and recitations, supplemented by textbook reading and study of charts analyzing various phases of industrial problems. The character of the course is descriptive and practical rather than theoretical, and the aim is to acquaint the student with the accepted principles of economics and some of their applications to industrial conditions.

The course will also deal briefly with economic history, showing how the present economic system has evolved from past systems and pointing out how the experience of the past can aid in the solution of present problems.

Besides the historical material, other topics discussed are the nature and scope of economics; the evolution of economic society; the three factors of production, land, labor and capital; the four elements in distribution, rent, wages, interest and profits; business organization; value and price; monopoly; money, credit and banking; international trade; protection and free trade; transportation; insurance; economic activities of municipalities; and public finance. In short, it is an outline course dealing with the fundamental principles that underlie a wide range of activities. [Courses IV, VI.]

COTTON DEPARTMENT — F

Cotton Carding—F-20. Preparation: B-10, B-12, B-14. This course extends throughout the second year and includes instruction starting with the growth, classes and characteristics of cotton and continues on through all the mill operations preparatory to spinning.

Cotton Production.—A study of the areas of the world producing cottons and the characteristics of the world's commercial cottons forms the major portion of this division of the work. Particular emphasis is given to the various American cottons. The different methods of ginning and the by-products from the cotton seed are studied here.

Cotton Marketing.—The customary methods of concentrating and distributing raw cotton come under this heading, which includes a study of the handling of cotton for spot sales and through the exchanges. It includes also a study of the classing of cottons, which involves instruction regarding the Federal Standards for classing and the terms commonly used by mills in handling purchases of cotton.

Opening.—The various machines used in opening raw cotton are studied in considerable detail, following which, typical layouts of the various machines in series, as used by different mills, are taken as illustrations of how these machines can be arranged for various conditions.

Picking—Particular emphasis is used in instructing the student in the new arrangements being developed for the picker room. Such standard subjects as eveners, lap measuring motions, grids and beaters are followed with illustrations of their application to the single process pickers. The effect of varying humidities on proper lap weights and future results in the card room are clearly pointed out under this heading. Draft, production and waste calculations complete the instruction on pickers.

Carding.—The process of carding is considered one of the most important, and proper time is devoted to the construction and operation of cards, that the student may be familiar with the various parts of the card and the function and design of each. The construction and application of card clothing, as well as the methods of grinding, form a part of the work. The proper procedure for operating cards to get the proper size and production and to keep them in proper mechanical condition to produce good work occupy considerable of the time given to carding. The calculations for draft, production and percent of waste completely cover these subjects as connected with carding.

Drawing.—Under this head is taken up the theory of doublings and their effect upon the quality of roving and yarn. Like previous and subsequent processes the machine construction forms an important part of the work. Proper stress is paid to such subjects as stop motions, drawing rolls and their covering, cleaners and evener motions. The calculations cover draft, production, roll crimp and improvement in uniformity.

Combing.—This process is explained by lecture work and by operation and assembling of the various types of combs in service in the laboratory. The object of combing is fully considered, and the different means employed on the many types of combers on the market is studied. This includes such types as the Heilman, New Whitin and Nasmith combers. Considerable time is spent in studying the many comb adjustments, their purpose and how they should be used to produce the desired quality of work. The proper care of the comb is explained. The subject includes the necessary calculations for draft, noilage and production.

Roving.—Under this heading the frames called the slubber, intermediate, fine and jack are studied. The numerous changes and adjustments necessary to produce good work are stressed, with special emphasis on the less obvious subjects of lay and tension. Both English and American types of frames are used. The cotton system for sizing rovings and yarns is studied here, following which, such calculations as draft, twist, lay, tension and production complete the work of the roving operations.

Laboratory.—An extensive series of laboratory projects are carried out simultaneously with the lecture instruction. These laboratory classes illustrate the principles developed in the class room and extend the class room work to practical application and operation. After work in classing raw cottons, cotton is processed using different adjustments, thus showing the results of the changes. Sufficient quantities of stock are processed so that the roving made is later spun into yarns and manufactured into cloth by the student. [Course I.]

Cotton Carding—F-20a. Preparation: B-10, B-12, B-14. This course is similar to Course F-20, except that there is much less time devoted to lecture and laboratory work. [Courses III, VI, Options G, C, D, S.]

Cotton Spinning—F-30. Preparation: F-20. This course extends throughout the third year and includes instruction on spinning, spooling, winding, twisting, reeling and baling.

Ring Spinning and Twisting.—This part of the course covers all kinds of ring spinning and twisting frames, their construction, principles of their actions and calculations. Particular emphasis is given to the production of yarns for different uses, in order that the desirable characteristics may be obtained. As the twister so closely resembles the spinning frame in many ways, the two operations are studied in succession to avoid duplication. The defects commonly found in yarns and methods of eliminating them require considerable attention. The methods of sizing yarns and the calculations for determining draft, twist and production are important factors in this work.

Mule Spinning.—Although less common than formerly in American mills, the mule is still of sufficient importance to warrant a study of its major motions. The advantages of mule yarns are clearly shown and the more common calculations for draft, twist and production are given.

Spooling and Winding.—These methods of preparing yarns for twisting and warping are fully explained. The machines are studied for the mechanical construction and adjustment. The calculations are largely in connection with production.

Reeling and Baling.—This work covers the winding of yarns into skeins on various types of reels, the calculations for producing skeins of a desired size and the adjustment of stop motions for measuring the desired yardage. The packing of skeins into bales follows the reeling.

Laboratory.—The laboratory work for this course consists of a series of projects particularly intended to illustrate the important features of the various machines and their products. In addition, considerable time is spent in producing yarns in sufficient quantities to give the student some practical experience in operating the machine and handling the rovings and yarns required. [Course I.]

Cotton Spinning—F-30a. Preparation: F-20a. This course is similar to Course F-30 except that there is much less time devoted to laboratory work. [Courses III, VI, Options G, C, D, S.]

Knitting—F-31. Preparation: B-12, D-10. This course, commencing with a study of hosiery yarns and their preparation for knitting, includes a study of the various stitches and their application in commercial fabrics; a study of the different knitting machines, including circular and flat, spring and latch needle machines, used in the manufacture of stockings, sweaters and underwear; and a study of looping and sewing machines. Part of the work consists of the assembling and adjusting of different types of knitting machines.

In addition, considerable time is spent in the analysis of knitted fabrics. [Courses I, II.]

Knitting—F-31a. Preparation: B-12, D-10. This course embraces the same lectures as Course F-31 but does not include any laboratory work. [Course VI, Options G, C, W, S.]

Cotton Organization—F-32. Preparation: F-20 or F-20a. This course correlates all the work in the Department of Cotton Yarns. The student is instructed how cotton yarn mill organizations are made, by the study of actual mill organizations, showing the drafts, doublings and sizes in use. This is followed by the calculation of machinery necessary to equip a given plant and the arrangement of this machinery in the mill building. Some time is given to the study of special equipment not specifically covered in other classes. [Courses I, VI, Options G, C.]

Thesis—F-34. Each student is required to present a thesis which is a report of some original work. This is sometimes the construction of some yarn or fabric to meet certain requirements. At other times the work is a study of some technical problem regarding the effect of certain changes in manufacturing conditions. [Course I.]

WOOL DEPARTMENT—G

Fiber Preparation—G–20. Preparation: B–10, B–12, B–13. Raw Materials.—A study of raw materials which enter into the manufacture of woolen or worsted yarns, or are made into yarns by processes similar to those employed in the manufacture of woolen and worsted yarns, would include silk, mohair, alpaca, vicuna, cashmere, camel's hair, cotton, flax, hemp, jute and ramie.

Wool Sorting.—Familiarity with the various grades and kinds of wool is obtained by lecture and by actual sorting of fleece wool under the direction of an experienced wool sorter. The various characteristics and properties are explained, as are also trade names, such as picklock, XXX, XX, ½-blood, ⅜-blood, ¼-blood, delaine, braid, etc. Some skill is acquired in the estimation of shrinkage and in judging the spinning qualities.

Wool Scouring.—The object of scouring and the methods employed are explained, and this involves the consideration of the soaps and chemicals used in washing; also the waste products and their utilization. Actual work is done in scouring a commercial quantity of wool by machines that are made similar in operation to regular commercial machines. A study is made of the effect of the hardness of water upon soap; also tests are made to show this effect. At the same time the use of dryers, their operation and regulation, is taken up.

Top Making and Combing.—This branch takes up in all detail the carding of wool on a worsted card, the preparing processes, back-washing and Vigoureaux printing, also gilling of the stock before and after combing. The construction of the gill boxes and combs is studied by lectures and by dismantling and assembling these machines in the laboratories. Later, quantities of stock are made into top and then into yarn.

The Noble comb is studied, and the various calculations to determine draft, noiling, tear, productions, etc., are made. [Courses II, III, VI, Options G, W, D, S.]

Woolen Yarn and Shoddy Manufacture—G–21. Preparation: B–10, B–12, B–13. Reworked Fiber or Shoddy.—Rags of all kinds are studied, sorted, and all processes necessary to convert them into fiber are covered in detail.

Wool Blending, Oiling and Picking.— Mixing and shading of colors and qualities of wool are studied and practiced. The details of Burr Pickers and mixing pickers including the Fearnaught are studied in full. The importance of oils and emulsions is stressed in lecture and laboratory.

Woolen Carding.—The system of carding wool for woolen yarn is fully explained, as is also the construction, setting and operation of the cards. A part of the work is the reclothing and grinding of the cylinders, strippers, workers, etc. The carding of suitable and commercial quantities of wool, and the further manufacture of it into yarn, serves to fix the principles of carding in the mind of the student, as well as to give him some skill in handling machinery.

Woolen Spinning—The computations necessary in converting roping into yarn are fully explained. The details of construction and operation of the spring and cam type mule are well covered in lectures and practice. The theory and practice of continuous or ring spinning for woolen is also taken up. The conditioning of yarn after spinning by steaming is explained.

Costs and details of a yarn mill are mentioned in brief as well as some causes of poor yarn and its effect on mill production. [Courses II, III, VI, Options G, W,D,S.]

Worsted Yarn Manufacture—G–30. Preparation: G–20. Intersecting Gill Boxes and French Comb.—The equipment of the laboratory offers opportunity for the production of dry-combed top and its comparison with oil-combed top produced on the Noble comb. The structures and uses of intersecting gill boxes and the study of combing and drawing blends is taken up at this point.

Drawing and Spinning.—The laboratory equipment consisting of the Bradford (English) system of drawing, of both open and cone types, as well as the various processes of French drawing, followed by both worsted mule and ring spinning frame, make possible a thorough study of the manufacture of worsted yarn by all of the existing methods.

The same method of study of mechanisms, calculations, and operations of the various machines is followed as in the case of previous methods of instruction. The

student by pursuing this course can compare the different methods of yarn manufacture and note the results of each.

ORGANIZATION.—At the end of the course the layout of a properly balanced yarn mill is studied, and at the same time the cost of machinery, depreciation, labor costs and machinery arrangements.

THESIS.—Before graduation the student must present visible evidence of his knowledge of woolen and worsted manufacture by the production of twenty yards of fabric from his own design (or reproduction or modification of some existing fabric) beginning with the raw material.

A formal typewritten description, including all calculations and observations, together with samples from each machine, must be presented to the head of the department before the final examination. [Courses II, III, VI, Options G, W, D, S.]

Textile Testing—G-31. Preparation: B-23, F-30 or G-30, D-24. The object of this course is to familiarize the student with present-day methods of determining the physical properties of textile fibers, yarns and fabrics. The application of physical laws and methods of measurements, as studied in the course of Physics, is used in the study of physical characteristics of textile material. The work is given to students in advanced courses, and consists of lecture and laboratory work. Reports are prepared from each experiment, giving the object of the experiment, method of procedure, observation and conclusions, in order that the student may acquire practice and understand the interpretation of data. A special testing laboratory is provided, and a considerable number of the best standard fiber, yarn and fabric testing instruments of foreign and American make have been installed and are used for instruction in the testing of textile materials. The laboratory is equipped with means for making and keeping the humidity constant, so that tests can be made under uniform or standard conditions of humidity and temperature. [Courses I, II, III.]

Technology of Wool and Allied Fibers—Lectures and Demonstrations—G-40. Preparation: C-21, C-32, D-10. This course is planned to supplement the instruction already given in design, cloth construction, chemical technology of fibers, scouring, dyeing and finishing, with sufficient lectures and demonstrations in sorting, scouring, backwashing, gilling, combing, top-making, English drawing, spinning, twisting, warping, and weaving, to make the processing of grease wool and allied fibers into ordinary worsted spun yarn fabrics, clear as to object and continuity.

The manufacture of virgin and reworked wool into woolen spun fabrics, with scouring, carbonizing, mixing, picking, carding, spinning, twisting, warping and weaving is also given. Illustrated descriptions of the manufacture of hardened, woven and needle loom felts are taken up.

Mechanical details and calculations are subordinated to familiarizing the student with the nature and object of the several processes. [Course IV.]

FINISHING DEPARTMENT—H

Woolen and Worsted Finishing—H-30. Preparation: B-12, C-10, D-10, D-24. The outline of this course, which is given by means of lecture and laboratory work, is as follows:—

BURLING AND MENDING.—Under this head is taken up for consideration the examination of flannel as it comes from the loom; the construction, use and location of the perch; the methods used in marking defects, measuring, weighing and numbering of cloths; also the methods of inspection for fancies, single cloths and double cloths. The object of burling, mending and the types of tables employed, the method of removing knots, runners, etc., the object of back shearing and the use of burling irons, the replacing of missing threads and the importance of sewing as a part of the finishing process, are all considered in detail. The removal of oil and tar spots as well as stains of various kinds is studied.

FULLING.—This branch covers a study of the conditions of the flannel as it comes from the loom, and the influence of oil, etc., upon the procedure. Considerable time is devoted to the various methods of producing a felt, the early types of stocks, hammer falling and crank stocks, and their modifications and development into the present type of rotary fulling mills of both the single and double variety. The details of construction in all machines are carefully taken up and

include the design and composition of the main rolls, methods of covering, regulation and means of adjusting the pressure of traps and rolls, consideration of the shoes, the use and regulation of the various types of stop motion, the different types of stretchers, guide rolls and throat plates.

The theory of felt is taken up and the influence of pressure, moisture, heat, alkali and acid is considered, as well as the hydroscopic and felting properties of different wool fibers. The preparation of the flannel for the mill and the usual methods of determining shrinkages, as well as the various methods of soaping, are given careful attention. The preparation of various fulling soaps and the value of each for the reduction of various degrees of felt as well as the determination of the proper amount of alkali for various goods, are carefully studied and demonstrated. The manipulation of the various kinds of goods in the mill, viz., all wool, shoddies and mixed goods, is studied in classroom and by operation in the mill.

The change in weight and strength for each operation is carefully considered, as is also the value of the flocks made in each. A study of the various methods of flocking, such as dry and wet, is considered in both class and machine rooms. In each operation the defects likely to materialize are studied, as well as the cause thereof, and various methods of modifying or lessening them.

Washing and Speck Dyeing.—This branch considers the scouring, rinsing and washing of goods both before and after the fulling process; the various types of washers; and the details of construction, such as suds box, rolls, etc. The theory of scouring, uses of Fuller's earth, salt solutions and scours on the different kinds of goods are made clear by practical work in the machine room, where the effects due to improper scouring, such as stains, cloudy effects, wrinkles and unclean goods, are demonstrated. The discussion of the necessity of speck dyeing follows naturally from the study of these matters, and includes methods of preparation, materials used, application and tests required.

Carbonizing.—This is an important branch of finishing, and includes a study of the various carbonizing agents, methods of application, strength of solutions, and neutralizing, as well as the machines used. Stains and imperfections resulting from carbonizing are also considered. The drying and tentering machines and extractors employed are taken up at this point.

Gigging, Napping, Steaming, Singeing and Crabbing.—The construction in detail of the various types of gigs, nappers, steamers, wet gigs, rolling, stretching, crabbing, and singeing machines is discussed, and their actions upon the cloth and the results obtained are explained.

Various methods of obtaining luster and the production of permanent finish are considered in connection with steaming and sponging.

Brushing, Shearing and Pressing.—This includes, as do the other branches, a careful treatment of the machine employed, the preparation of the cloth for each process, the action of each machine in producing its part of the resultant effect. In manipulation of the shear consideration is given to its setting, grinding and adjustment. With the brushing machine the effect of steaming and moisture upon the luster and feel of the goods is shown. A study of the action of the presses, both plate and rotary, involves consideration of pressure, steaming, etc. Special processes to obtain particular effects are taken up, and the part played by each machine is explained. The details involved in handling cloth on a commercial scale, as, for example, measuring, weighing, ticketing, numbering and rolling, are also explained. The necessary calculation and the methods of finishing all grades of goods are considered from time to time during the year. [Courses II, III, IV, VI, Options G, W, D, S.]

Cotton Finishing—H-31. Preparation: B-12, C-10, D-10, D-24. The outline of the course in the finishing of cotton fabrics is as follows:—

Cloth Room.—Instruction of the various goods and the object thereof; construction of the various types of inspecting and trimming machines.

Shearing.—The object. A consideration of the various types of shears for treating one or both sides at the same time; also the use of the usual cleaning devices, such as emery, sand and card rolls, beaters and brushes; grinding and the adjustment of the various parts.

The use of brushing and cleaning machines, rolling devices and calender attachments for gray goods.

Singeing.—Developing and object of singeing; the construction of singers of all types and for various purposes; the use of cooling tanks, steaming devices, rolling and brushing attachments.

Regulation of the flame for various goods, and adjustment of the parts; gas and air pressure, water-cooled rolls; the effect of moisture on the cost of singeing and use of dry cans in connection with singeing; electric singeing.

Washing.—Open width and string washers, their construction and operation; soaps, temperature, squeeze rolls; washing of various goods and the object thereof; stains.

Napping.—The object of napping and the usual method of treating goods; various types of nappers, single and double acting; felting nappers; construction, grinding and adjustments of various types.

Water Mangles.—Their objects and the construction of various types; various rolls, iron, husk, etc.; scutchers, their object and constructions.

Starch Mangles.—The object and construction of all types of starch mangles for pure starch and filled goods; various types of rolls, brass, rubber, wood; action of doctor blades, etc.; regulation and object of pressure.

Methods of starching and finishing all standard goods, also a consideration of the various substances used, such as starch, softener and fillers; the preparation of starch and various methods of application.

Dryers and Stretchers.—Both horizontal and vertical types of drying cans, tenter frames, clips, etc.; the swing motion and the finishes thus produced; object and construction of spraying machines, belt stretchers, short tenters, button breakers, etc.

Calenders.—The object and construction of all types, including the regulation of pressure and nips for the production of various finishes; various types of rolls and their uses,—steel, husk, cotton, paper, etc., the use of hot and cold rolls; chasing, friction, embossing and Schreiner calenders, and the various finishes produced by each; production of watered effects; beetling machines and hydraulic mangles.

Making-up room,—yarding, inspecting; different types of folds; pressing, papering, marking. [Courses I, III, VI, Options G, C, D, S.]

PHYSICAL EDUCATION

All members of the freshman class are required to take a course in physical training conducted in the gymnasium under the direction of an instructor in physical education. Two periods per week for the entire first year are devoted to this work. At the beginning of the year a full record is made of the physical examinations carried on by the instructor and a reputable physician that proper and beneficial exercise may be prescribed.

The object is to give general instruction in the care and strengthening of the body, and to so guide the students that they may continue to give proper thought to their physical training that their mental development may have its greatest effect.

Proper gymnasium clothing is required and all students must take a shower bath following each exercise.

EQUIPMENT

The equipment of machinery, inventoried at $330,850.00, is most varied for textile educational purposes, and is being constantly augmented. The builders of the various machines installed keep in close touch with the Institute, adding to the machines such improvements as are made from time to time, and each year some new machine will be added by a manufacturer who finds it to his advantage to be represented here. This operates to the mutual advantage of student and manufacturer.

Cotton Yarn Department.—The opening and picking section of this department contains a 50-saw Pratt gin used for experimental purposes. For classing work, there is a specially equipped section with north light, where Universal Standard Grades and Government Staple Standards are available.

The picking equipment consists of two Kitson pickers, one 40-inch two beater breaker lapper with an automatic feeder and one 40-inch finisher lapper with a Perham and Davis evener. There is an extra Kirschner patent carding beater to be used in this finisher picker.

The card section has three standard revolving flat top cards, one each from Saco-Lowell, Whitin, and Howard and Bullough shops. One of these is equipped with a Chapman electric neutralizer to prevent trouble from static electricity.

The combing section consists of a sliver lapper, one four-head ribbon lapper, one two-head comb, and one eight-head comb, all from the Whitin Machine Works. There is also one two-head Nasmith comb from John Hetherington and Sons of England.

The drawing frames are all of the single head type. There are two four-delivery drawing frames and one railway head from the Saco-Lowell Shops. One frame is equipped with both common and metallic drawing rolls, electric stop motions and Ermine top roll clearers. The other frame and the railway head both are equipped with metallic rolls and mechanical stop motions. Another frame of two deliveries is from the Howard and Bullough shops. It has electric stop motions and metallic drawing rolls.

The roving section has a complete equipment, slubber, intermediate, fine and jack frame from the Saco-Lowell Shops. In addition, there is an intermediate frame made by the Woonsocket Machine and Press Company, and a fine frame from Howard and Bullough. The last named serves to illustrate the common English construction and how it differs from the American construction as illustrated in the other roving machines.

The spinning equipment is quite varied both with respect to builders and with respect to types and sizes. The Saco-Lowell Shops have supplied five different frames varying from 36 to 216 spindles. They are suitable to spin counts from 3s to 80s. One is equipped with the LeBlan Roth long draft system, while another has a special five roll long draft system built in the Institute. A sixth Saco-Lowell frame was supplied by the Acme Machine Company equipped with Chapman ball bearing spindles. Four of these frames are equipped with individual motor drives,—one chain drive, one Texrope drive, one gear drive and one Washburn clutch drive. The Whitin Machine Works is represented by three frames on which counts from 3s to over 100s can be spun. One of these frames has an auxiliary equipment of SKF roller bearing spindles and is fitted on one side with Casablanca long draft equipment. The Howard and Bullough shops have one spinning frame suitable for counts from average to fine. This is equipped with an English type of builder which distinguishes it from the other frames. One Fales and Jenks frame is present, equipped on one side with the Casablanca long draft system. This machine is equipped with an individual alternating current motor with a chain drive. One spinning mule has been retained to illustrate this peculiar type of spinning. It is from Asa Lees Company of England and is suitable for counts above 30.

There is one short spooler from the Saco-Lowell Shops. There are two winders from the Foster Machine Company, one for single ends either on cones or tubes, the other for one, two, or three ends parallel wound, especially for preparation for twisting. There is also a one gang Universal No. 50 winder suitable for winding ordinary tubes or Franklin Process packages.

The twisters are suitable for all counts. There is one each from the Saco-Lowell, the Howard and Bullough, and the Fales and Jenks Shops. These are all equipped for either wet or dry twisting of average and fine counts. There are two twisters from the Draper Corporation. These are equipped for wet or dry twisting for coarse counts or heavy plies.

The department has a complete coiler waste system as made by the Saco-Lowell Shops, consisting of a 40-inch single coiler side delivery breaker card; a 40-end derby doubler; a 40-inch four coiler finisher card; a combination slubber-intermediate and a waste spinning frame. This equipment is suitable to spin coarse numbers from cotton wastes to be used in such materials as coarse sheeting, osnaburgs, twine and mop yarns.

To prepare mill wastes for re-use there is one single cylinder roving waste opener and one thread extractor, both from the Saco-Lowell Shops.

With the exception of the opening-picking room the humidity in this department is controlled automatically by a system installed by the American Moistening Company. Seven high duty heads supply the necessary moisture and air circulation. An adjustable automatic control regulates the humidity to the desired per cent.

The experimental laboratory is equipped with a power driven skein tester for determining yarn strength and a Moscrop single thread tester for single end strength. There are twist counters for determining the amount of twist and the twist contraction. For fine work and for fiber study, there is an analytical balance and a Spencer microscope equipped with three objectives, three oculars, ocular micrometer, mechanical stage and Abbé condenser. In addition, there is a gas conditioning oven to use in determining moisture content and regain. A number of scales and balances, together with yarn reels, roving reels and measuring boards make up the equipment for routine mill sizing tests.

Knitting Section.—The winders for this section include a six-spindle Universal winder for cones and tubes and a Payne bobbin winder.

The machines in the following group are equipped with special attachments for producing high splicing, double soling and striped work. The hosiery machines include two Acme full automatic, one arranged for 160 needles and the other for 200 needles; also a Mayo Model C full automatic arranged for 220 needles. Scott & Williams have placed in this section four of their machines, Models B-5, K, HH and RI. There are three Banner machines, all full automatic, two of which are arranged for 220 needles each and one arranged for 160 needles. There is one Brinton full automatic arranged for 176 needles and one Branson hand machine arranged for 80 needles. For hosiery legs and tops there are five ribbers, made by the Wildman Company, with cylinders varying from 3½–5¼ and arranged for needles varying in number from 160–240; two Brinton ribbers, one arranged for 176 needles and the other 200 needles; one Brinton tie machine, 1¾-inch cylinder 100 needles and 49 needles; one Universal Ribber 3½-inch diameter, 160 needles. To illustrate the fully fashioned type of knitting hosiery there is an 18 section, 39 gauge Reading legger, with topping stand.

The underwear machinery consists of one Crane spring needle machine, one Scott & Williams ribber, and one Wildman ribber.

Under the group of flat machines there are three Lamb machines, one arranged for knitting gloves and one arranged for knitting sweaters. In addition to these there is also a Grosser sweater machine, a Jacquard machine, and a link and link machine; a Dubied scarf machine; and a Raschel warp knitter.

For finishing work this section includes a Grosser 2-thread looper, one Hepworth looper, two Beattie loopers; five Union Special sewing machines for overseaming, double stitch covering, seaming and welting and vest finishing; six Merrow sewing machines, including two shell stitch machines and three overseaming and crocheting machines; three Singer machines; three Wilcox & Gibbs sewing machines, including a flat lock machine.

The Philadelphia Metal Drying Form Company has installed a table of six forms including men's, women's and children's.

For instruction in the manufacture of braids the New England Butt Company has installed one 24-line Hercules braider, one 12-line braider, one tubular braider, and one soutache braider.

Woolen Yarns Division. — The following machinery and equipment is available for use in the manufacture of yarn on the woolen principle.

Installed by Davis & Furber Machine Company of North Andover, Mass.: One wool mixing picker equipped with hopper feed (George S. Harwood & Son), one modern 60x40 three cylinder set of cards, single breaker and double finisher, each driven by Westinghouse variable speed motors through silent Whitney chains, improved Bramwell breaker feed by Harwood & Sons, Davis and Furber Broadband intermediate feed and 80 end four bank single apron tape condenser with all change gears and pulleys; one set 48x40 cards with single breaker, intermediate, and finisher cylinders, Bramwell breaker feed, latest type Apperly-Harwood transfer feeds with 40 end ring doffers and two apron condenser; one Model B latest type woolen ring spinning frame, motor driven, with 60 spindles 2½-inch rings; one 120 spindle spring mule with bobbin holders by the American Bobbin Holder Company; one

mule headstock mounted on trucks for instruction purposes; one fancy yarn twister with chain and gear equipment; one filet winding drum stand with tension bars, wind, etc., for applying card clothing.

Installed by C. G. Sargent's Sons Corporation, Graniteville, Mass.: One multiplex burr picker for medium wools, one yarn conditioning machine with motor drive.

Installed by Johnson and Bassett, Inc., of Worcester, Mass.: One 120-spindle cam mule complete; one mule headstock mounted on trucks for instruction purposes.

Installed by Torrance Manufacturing Company: One sample mixing card for blending and matching wool.

Installed by B. S. Roy & Son, Worcester, Mass.: One card grinding stand with two traverse grinders complete.

Equipment: Modern ferrule type fiber head jack spools and bobbins by U. S. Bobbin and Shuttle Company of Lawrence; yarn baskets by Steele Supply Company, Cambridge, Mass.; hand cards by Howard Brothers of Worcester and Davis & Furber Machine Company; ring travellers by Victor Company; static suppressors by Chapman Neutralizer Company.

Shoddy or Reworked Fiber Division. — Installed by C. G. Sargent's Sons Corporation: One cypress screw acid dip tank; one single apron dryer (baker); one cone carbonizing duster with crush rolls.

Installed by Schaum & Uhlinger, one steam hydro-extractor.

Installed by C. S. Dodge of Lowell, one ball bearing rag picker with condenser, one bagging stand.

Installed by John T. Slack Corporation are hundreds of samples of reworked wool in all stages from rags to fiber.

Wool Preparing Division. — Wool sorting and grading is carried on under excellent conditions with the following equipment: sorting bench, baskets, bagging stands, etc.

Installed by C. G. Sargent's Sons Corporation: One grease wool cone duster, one four bowl scouring train with large hopper feed; one single apron dryer with large feeder.

Top Making Division.—Top for the Bradford or French system is made with the following machinery: One double cylinder worsted card (four licker-in) with can coiler and balling head, complete, by Davis & Furber Machine Company, and with a Bramwell automatic feeder supplied by George S. Harwood & Sons. An electric neutralizer is furnished on card by the Chapman Electric Neutralizer Company. This section also includes a double bowl, 5-cylinder backwasher, with gill box, Taylor-Wordsworth & Co., Leeds, England, equipped with blueing motion, oiling motion, and Layland patent pressure motion; a weigh gill box and creel and one doubling balling head gill box (with double screws) made by the Saco-Lowell Shops of Lowell, Mass.; two worsted combs with baller punch, one made by Crompton & Knowles, Worcester, and the second made by James Smith & Sons, of Worcester, Mass.; two finishing gill boxes, one known as a can gill box and the other a balling head gill box, both made by Hall & Stell, Keighley, England.

Worsted Yarn Division. — Bradford or English System: For the manufacture of yarns under the Bradford System of Drawing, Spinning, and Twisting, the following machinery as made by Prince Smith & Son, Keighley, England, make up the equipment: one revolving creel for 12 balls, one 2-spindle drawing box, one 4-spindle first finisher, one 12-spindle dandy reducer, one 12-spindle cap spinner, one double head can gill box, one 2-spindle gill box, one 2-spindle flyer spinner, one 12-spindle ring spinner, one 12-spindle 2-fold cap twister, one 12-spindle 6-fold ring twister. In addition to this the Saco-Lowell Shops, Lowell, Mass., have installed the following machinery to carry on similar work: one 2-spindle drawing box, one 6-spindle second finisher, one 24-spindle dandy rover, one 6-spindle cone reducer, one 8-spindle cone rover, one 48-spindle cap spinner, 5-foot end, one 48-spindle cap spinner, 4-foot end, one 48-spindle Boy ring twister. The Universal Winding Company has installed one of its 6-gang winders, equipped for cones or straight tubes. The Lindsay-Hyde Company has installed a modern skein winder.

The humidity in the laboratory of the woolen yarns and of the English system of worsted yarns is maintained by the American Moistening Company's system through its automatic control. In this laboratory are installed six humidifiers and four Comin's High Duty heads, which are supplied from an electric-driven triplex power pump located in the power house. This same pumping equipment supplies the American Moistening Company's humidifiers operating in the Cotton Yarn Department.

French System. — For the manufacture of worsted yarns under the French System of Drawing and Spinning the machinery has been made by the Société Alsacienne de Constructions Mechaniques, Mulhouse, France, and the equipment consists of the following: Model P. L. B. comb with creel for 24 doublings, intersecting gill box (2 heads), gill box (2 heads), first drawing (2 heads), second drawing (2 heads), third drawing (2 heads) reducer (4 porcupines), slubber (8 porcupines) first intermediate (8 porcupines), second intermediate (8 porcupines) rover (8 porcupines), finisher (16 porcupines), self-acting worsted mule (150 spindles).

The Saco-Lowell Shops built and installed a ring spinning frame of 60 spindles for worsted yarns equipped with individual General Electric Company's motor and a Reeves Variable Speed Transmission.

Twelve turbo humidifier heads automatically controlled by a humidity regulator have been furnished by the G. M. Parks Company, Fitchburg, Mass. The compressed air for these heads is supplied by an Ingersoll-Rand 8 by 8 steam-driven air compressor.

Textile Testing Division. — Complete equipment is available for testing all kinds of fibers and fabrics under controlled conditions for breaking strength, elasticity, elongation, physical structure, moisture content, oil content, thickness, bursting strength, count of yarn, yards per pound, twist, resistance to abrasion and other tests of commercial or experimental importance. This equipment includes the necessary microscopes and micrometers, a skein-testing machine, and electric conditioning oven made by the Emerson Apparatus Company of Boston; single yarn and fabric strength-testing machines made by G. R. Smith & Company, Bradford, England; a strength-testing machine, capacity 500 kilograms, for testing twines and fabrics; a fiber-testing machine for testing fibers and fine yarns with capacity, 1 gram to 1.5 kilograms; a yarn strength-testing machine with capacity 1,000 to 5,000 grams; and a yarn strength testing machine with capacity 5 to 30 kilograms, all of which have been made by Louis Schopper, Leipzig, Germany. In addition to these there is a standard yarn and fabric testing machine made by Henry L. Scott & Company of Providence, R. I., a Mullen Tester, a special abrasion machine for testing the resistance to wear of carpets and other pile fabrics, also an abrasion machine for testing resistance to wear of twines, tapes, and all stripped flat fabrics, one General Electric mercury vapor lamp with stand for top inspection. For the automatic control of temperature and humidity there has been installed by the American Moistening Company, of Boston, one of its automatic humidity and temperature regulators.

Design and Power Weaving Department.—In the fabric analysis section there have been provided chemical balances made by Voland & Sons and Christian Becker, necessary twist testers, microscopes, reels, etc., as well as a Torsion calculation balance made by the Torsion Balance Company of New York.

In the warp preparation department there has been installed by the Saco-Lowell Shops one of its spoolers, besides a slasher for preparing cotton warps; a high speed warper, by T. C. Entwistle Company of Lowell. The Whitin Machine Company, Whitinsville, Mass., has supplied a 180-spindle, long chain quiller, and the Johnson & Bassett Company, Worcester, Mass., a quiller of its make. The Universal Winding Company has supplied a winder for cop and bobbin winding and an 8-spindle doubler. Also a winder for the high speed warper.

The woolen and worsted warp preparation department contains two 40-end jack spoolers, two spool racks for 12 spools each, one pattern dry frame dresser, one pipe and cylinder dresser, one 60-inch reel, one 82-inch reel, and one double head beamer, all supplied by the Davis & Furber Machine Company of North Andover, Mass.

The Weaving Department contains four looms supplied by the Draper Corporation of Hopedale, Mass., which include a plain Northrup, an 8-harness corduroy, an improved Northrup, a Northrup with dobby. The Stafford Loom Company of Readville, Mass., has installed one plain, one cam, one dobby loom and one broad sheeting loom, all equipped with individual motors; the Whitin Machine Works, Whitinsville, Mass., a side cam twill, a plain print cloth loom, equipped with Kip-Armstrong electric warp stop motion; Crompton & Knowles Loom Works a jean loom and a plain loom with individual drive. Four of these looms are equipped with Abbott cleavers made by the Abbott Wire and Cast Steel Warp Cleaving Company, Lisbon Falls, Maine. The Hopedale Manufacturing Company of Milford, Mass., has recently installed one of its high speed looms with individual motor.

The fancy loom section includes a Stafford Ideal 16-harness automatic shuttle-changing loom, a Whitin 20-harness dobby loom, and the following furnished by the Crompton & Knowles Loom Works: Knowles gingham 4 by 1 boxes, Crompton gingham 4 by 1 boxes, one Crompton towel 2 by 1 boxes, two Terry towel and one huck towel looms, a 16-harness lappet loom, a 20-harness dobby 4 by 1 boxes, fancy leno loom, and a Crompton fancy cotton single cylinder 20-harness dobby.

The woolen and worsted section contains a Knowles 20-harness Gem, a Crompton 24-harness worsted 4 by 4 boxes, a Crompton 6 by 1 double cylinder 20-harness dobby, one heavy 20-harness 4 by 4 boxes, one 20-harness and one 25-harness blanket, seven intermediate woolen 25-harness 4 by 4 boxes and two 90-inch 25-harness heavy woolen looms.

The Jacquard loom section includes one Stafford silk loom, 1,200-hook, Halton head; one 400-hook, single-lift Schaum & Uhlinger Jacquard, mounted for 4-bank, narrow fabric loom; one Skinner Brussels carpet loom, three-quarters wide, equipped with 1,280-hook Jacquard head presented by the Bigelow-Hartford Carpet Company, Clinton, Mass. The Crompton & Knowles Loom Works has furnished one Knowles fancy loom, single-lift Jacquard; one Knowles fancy loom, double-lift Jacquard; one Knowles fancy loom, Jacquard tied up for leno, one Knowles loom, 4 by 4 boxes, 54-inch, with 600-hook, double-lift, double-cylinder McMurdo Jacquard head, tied up for damask napkin designs; one Crompton & Knowles 72-inch tapestry loom, with 2,600-hook Halton Jacquard head, one 840-hook, double-lift, single-cylinder Jacquard on Crompton & Knowles 4-bank ribbon loom, one 800-hook, double-lift Knowles Gem silk brocade Jacquard machine, 4 by 4 boxes.

The silk loom section includes one Stafford silk loom, 20-harness dobby, 2 by 1 box motion, sliding bar warp stop motion, filling feeler, extended beam stands, motor drive; one Crompton & Knowles silk loom, 4 by 4 box motion, 20-harness head motion, individual motor drive.

For the purpose of card cutting there has been furnished one Jacquard fine index card-cutting machine by John Royle & Sons, Paterson, N. J.; one Jacquard French index card-cutting machine by the same concern.

Chemistry and Dyeing Department.—The Chemistry Laboratory consists of one to give instruction in General Chemistry and Qualitative Analysis and provides facilities to take 120 students. The Quantitative Laboratory takes care of some 50 students and contains the necessary drying closet, steam bath, electrolytic table, with ample facilities to provide distilled water through the use of a Barnstead Water Still. The Balance Room, which is adjacent to the laboratory, has eleven analytical balances made by such concerns as Christian Becker, Eimer & Amend, and H. L. Becker's Sons & Company. The Organic Laboratory has facilities to take care of approximately 25 students having the necessary equipment required in the preparation of basic organic compounds and instruments used in the manufacture of dyes such as autoclaves, electric and gas combustion furnaces.

For the purpose of carrying on photographic and microscopic experiments and analyses the laboratory has been provided with equipment which includes besides the Bausch & Lomb microscopes, a polariscope made by Franz Schmidt & Haensch, Berlin, Germany, a Gaestner spectroscope, a Bausch & Lomb Model G photomicrographic apparatus equipped with D. D. S. microscope and all necessary apparatus, a Kodak projection printer. Besides the common gas and electric lamps

there is installed a solar determinator, made by the Atlas Electric Company, Chicago, Ill., also a 400-watt Nela Trutint and color-matching unit made by Nela Specialties Division, Cleveland, Ohio.

The Chemical Museum has been provided with cases and representative dyestuffs all furnished by various dyestuff manufacturers of this country and abroad. This offers an unparalleled opportunity for students to study and experiment with almost all of the representative dyes which are used in the textile industry.

The Experimental Dyeing Laboratory is equipped with individual benches, small dyeing apparatus, reels, balances, apparatus for dye testing, such as frames for exposing dyed material to light, and a complete collection of dyestuff samples and sample cards. There are also fifty-six steam coil experimental dyeing baths, a drying chamber and ageing chamber, in addition to a Hurricane Dryer, Class D, made by the Philadelphia Drying Machinery Company, Pennsylvania. Adjacent to the Experimental Dyeing Laboratory there has been provided a well-lighted room for the storage of a great variety of dyestuffs. Steel shelving has been arranged so that the samples are easy of access. All samples are catalogued in a card file, thus facilitating their use.

The Experimental Printing Laboratory is equipped with a power driven calico printing machine, made by Rice, Barton & Fales, Worcester, Mass., an iron-jacketed steaming chamber, and a set of steam jacketed copper kettles.

The Fuel and Oil Analysis Laboratory contains the following equipment for the analysis of coals and fuels: a Mather bomb calorimeter, an Emerson bomb calorimeter, a Parr calorimeter, an Abbé refractometer, a Torsion and a Tagliabue viscosimeters, a Tagliabue cold test apparatus, a Pensky Martin oil tester, a New York State oil tester, a Sartorius specific gravity balance, two Becker analytical balances, gas muffle furnace, Kny-Scherer oil tester, a Graefe gas calorimeter, an Orsat gas analysis apparatus, laboratory tables, lockers, and hoods.

The Industrial Chemistry Laboratory contains the following: one filter press, Type E. T. Shriver & Company; a single-acting triplex plunger pump, Goulds Manufacturing Company; a vacuum drying apparatus, a surface condenser, a Packard vacuum pump, Norman Hubbard's Sons; a vacuum evaporator, Swenson system, American Foundry and Machine Company; a centrifugal, C. H. Chavant & Company; a double jar mill, F. I. Stokes & Company.

To give instruction in dyeing on a basis which is more comparable with commercial practice there is provided a laboratory which includes the following equipment: a small kier, fitted with E. D. Jefferson's circulating device, a Permutit filter, the Permutit Company, New York City; a mercerizing machine, raw stock and yarn dyeing machines, Klauder-Weldon Dyeing Machine Company; a jig dyeing machine, the Textile-Finishing Machine Company, Providence, R. I.; a set of drying cans by the same concern; a chain dyeing machine, T. C. Entwistle Company, Lowell, Mass.; a raw stock drying table, Proctor & Schwartz, Philadelphia, Pa.; a padding mangle, Arlington Machine Works, Arlington, Mass.; a hydro-extractor, W. H. Tolhurst & Son, Troy, N. Y.; a Psarski experimental dyeing machine, a Hussong experimental dyeing machine, equipped for raw stock or yarns, a Rodney Hunt sample piece dyeing machine, equipped with an automatic temperature and pressure-regulating apparatus, made by C. J. Tagliabue Manufacturing Company, Brooklyn, N. Y. The Franklin Process Company, Providence, R. I., has furnished a 25-pound bronze dyeing machine. Of the various dye tubs, one is equipped with a Monel metal lining to withstand the action of various chemicals and dyes.

Finishing Department.—The Woolen and Worsted section includes a motor-driven Clipper cloth 4-string washer, a fulling mill, and a combination fulling and washing mill for jersey fabrics, furnished by the Rodney Hunt Company, Orange, Mass.; a sample fulling mill, a kicker mill, furnished by James Hunter & Company, North Adams, Mass.; an up and down dry gig, a rolling and stretching machine, an up and down wet gig, a steam finishing machine, a 60-inch, 3-burner singeing machine, adapted for cotton, silk or worsted goods, a 2-cylinder double-acting brushing machine. Curtis & Marble Machine Company of Worcester has furnished a 60-inch 4-cylinder sanding and polishing machine; a mantle steaming and air cooling machine, equipped with a direct connected motor and a Nash pump; and a 66½-inch motor driven, single woolen shear, equipped with list saving moti on;

6-4 double shear, an A. W. C. measuring and weighing machine, furnished by Parks & Woolson, Springfield, Vt.; a dewing machine, a 6-4 Voelker rotary press, furnished by G. W. Voelker & Co., Woonsocket, R. I.; a tentering and drying machine furnished by John Heathcote, Providence, R. I.; a single crabbing machine, H. W. Butterworth & Son, Philadelphia, Pa.; a 72-inch woolen napper donated by Davis & Furber, North Andover, Mass.; a 32-inch basket hydro-extractor, W. H. Tolhurst, Troy, N. Y.; a Lintz & Eckhardt cloth numbering machine, from Durbrow & Hearne Company, New York; a steam press for underwear, United States Hoffman Company, Syracuse, N. Y.; a sewing machine, Birch Brothers, Somerville, Mass.; a trimming and overseaming machine, The Merrow Machine Company, Hartford, Conn.

The Cotton section includes a 40-inch inspecting and brushing machine, a 44-inch No. 25 railway sewing and rolling machine, a 44-inch cotton shearing machine, Type No. 34, a 44-inch No. 3 steam calender rolling machine, a 40-inch cloth folder, a 40-inch winder and measurer, a set of 44-inch shear blades for grinding purposes, furnished by Curtis & Marble Machine Company, Worcester, Mass.; a 48-inch No. 4 opening, sewing and rolling machine, a No. 1 hand power portable railway sewing machine, furnished by Dinsmore Manufacturing Company, Salem, Mass.; a 40-inch 4-tank open soaping machine equipped with patent flushing rolls, brass and rubber squeeze rolls and spiral openers, furnished by Birch Brothers, Somerville, Mass.; an 84-inch 36-roll, ball bearing, double acting napper, equipped with a 7½-horsepower General Electric motor drive, furnished by Davis & Furber, North Andover, Mass. (the ball bearings were donated by the Fafnir Bearing Company, New Britain, Conn.); an 8-inch belt lacer furnished by the Clipper Belt Lacer Company of Grand Rapids, Mich.; a 40-inch, 3-roll water mangle, with husk and brass rolls and usual attachments and equipped with a 48-inch Mycock scutcher, and a 40-inch Mycock cloth expander made by Thomas Leyland & Company, Boston; a 40-inch, 2-roll starch mangle, a 40-inch upright drying machine with 10 copper cylinders equipped with Files dry can system, Files Engineering Company, Inc., Bridgeport, Conn.; a 40-inch sprinkler, a 40-inch, 5-roll Universal calender with chasing attachment and equipped with a 40-inch Mycock cloth expander, a pasting table with plate, furnished by the Textile-Finishing Machinery Company, Providence, R. I.; a 16 by 24 inch bronze-covered stretcher for the drying cans, C. A. Luther & Company, Providence, R. I.; a 40-inch double bristle stretcher for drying cans, American Finishing Machinery Company, Boston, Mass.; a trimming and overseaming machine, The Merrow Machine Company, Hartford, Conn.; a 40-inch Tommy Dodd starch mangle, and a 44-inch, 50-foot vibratory tentering machine, H. W. Butterworth & Sons Company, Philadelphia, Pa. This machine is directly driven by a 7½-horsepower variable speed motor and is equipped with a Schwartz automatic electric guider, made by L. H. A. Schwartz & Company, Boston, Mass.

Engineering Department.—The Steam Engineering Laboratory contains the following equipment arranged for experimental purposes: A 50-horsepower Allis-Chalmers Corliss steam engine direct connected to an Alden absorption dynamometer, and piped to exhaust its steam to the atmosphere, to a Wheeler surface condenser or to the Kerr turbine; a Kerr seven-stage turbine driving directly a 25-kilowatt Richmond Electric Company's alternating current generator and piped to exhaust either to the atmosphere or the condenser. It may be operated either as high pressure or low pressure turbine, and the generator has special connections to illustrate various commercial phases. In addition there are a 4 by 6 Deane triplex power pump, two 2-inch centrifugal pumps made by Lawrence Machine Company, Lawrence, Mass., a Clayton air compressor and necessary tanks, scales and measuring instruments. For the measurement of flow of air there are a steam-driven Sturtevant fan and a motor-driven Massachusetts fan with heater combined for heating and drying experiments.

The Electrical Engineering Laboratory consists of two sections, one of which is devoted to instruction in the generation and transmission of power, and contains the necessary switchboard and instruments to control a 25-kilowatt alternating current turbo generator and a 15-kilowatt motor generator set arranged to supply either direct or alternating current. In addition there are a 24-horsepower direct current Allis-Chalmers motor and a 10-horsepower direct current General Electric motor, also a 10 and a 7.5 horsepower General Electric alternating current motor

besides a General Electric 3-kilowatt rotary transformer and three Westinghouse stationary transformers. The other section of the laboratory is known as the instrument laboratory and is for the purpose of giving instruction in the measurement of current voltage, resistance, and in the calibration of instruments. It contains a 5-kilowatt Crocker-Wheeler balancer, a 160-ampere hour storage battery, a 5-kilowatt 220-volt to 440-volt General Electric transformer, a Westinghouse portable wattmeter with current and potential transformers, three wattmeters, two ammeters and a voltmeter, all of the General Electric portable alternating current type, a 30-volt alternating current Roller Smith voltmeter, a 5 to 10-scale Weston ammeter (electro-dynamometer type), a Weston millivoltmeter with 2, 20, 50 and 200 ampere shunts, three 250-volt direct current Weston voltmeters, a 150-ampere, two model 45, two model 260, Weston portable ammeters, a Weston model 260 voltmeter, a Thompson 50-ampere recording wattmeter, a General Electric rotating standard wattmeter, two General Electric induction type watt hour meters, an Esterline portable curve drawing wattmeter, a 100-ampere Leeds & Northrup Standard Resistance, a Leeds & Northrup Ayrton shunt, a Weston laboratory standard voltmeter with 600-volt multiplier, a Leeds & Northrup potentiometer, a D'Arsonval wall type galvanometer, a Wheatstone bridge with galvanometer, a slide wire bridge and electro-dynamometer, Weston Standard cell, potential phase shifter, a standard Leeds & Northrup photometer with Lummer-Brodhun screen, and Macbeth illuminometer made by the same concern.

Machine Shop.—The equipment of the machine shop is as follows: Four standard engine lathes, 13-inch swing, 6-foot bed, and an engine lathe, 18-inch swing, 10 foot bed; three standard engine lathes, 14-inch swing, 6-foot bed, from Flather & Company, Nashua, N. H.; a standard engine lathe, 15-inch swing, 6-foot bed, from F. E. Reed Company, Worcester, Mass.; an engine lathe, 18-inch swing, 6 foot bed from Champion Tool Works, Cincinnati, Ohio; a standard engine lathe, 15-inch swing, 6-foot bed, from S. H. Putnam Sons, Fitchburg, Mass.; one No. 1 Universal milling machine, with all three feeds automatic, from Kempsmith Manufacturing Company, Milwaukee, Wis.; one 24 by 24 inch, 6-foot planer, from the Mark Flather Planer Company, Nashua, N. H.; one 23-inch upright drill, with back gears and power feed, from J. E. Snyder & Son, Worcester, Mass.; one 14-inch single sensitive drill, from the Stanley Manufacturing Company, Lawrence, Mass.; one No. 1 Universal grinder, from Landis Tool Company, Waynesboro, Pa.; five speed lathes, 17-inch swing, 5-foot bed, one 20-inch wet tool grinder, and one 12-inch, 2-wheel dry grinder, from J. G. Blount, Everett, Mass.; an American twist drill grinder, from the Heald Machine Company, Worcester, Mass.; one Type 1B portable electric grinder from the Cincinnati Electric Tool Company, Cincinnati, Ohio; one 30-inch grindstone and frame, from the Athol Machine Company, Athol, Mass.; a single spindle centering machine, from D. E. Whiton Machine Company, New London, Conn.; one 15-inch shaper, from Potter & Johnson, Pawtucket, R. I.; one power hacksaw, from the Fairbanks Company, Boston, Mass.; one cold saw, from John T. Burr & Son, Brooklyn, N. Y.; one Eureka metal power saw, Manning, Maxwell & Moore; one Type CC electric drill, Cincinnati Electric Tool Company; one Universal milling attachment for Kempsmith milling machine, and one Hisey Type B ½-horsepower tool post grinder, Taylor Machinery Company; one No. 2 Cory bench straightener, Manning, Maxwell & Moore; one No. 3 Universal cutter and reamer grinding machine, Browne & Sharpe; a well-equipped tool room containing a selected stock of the best makes of small tools, such as drills, taps and dies, milling cutters, reamers, gauges, micrometers, etc.

Power, Light, Heat and Ventilating Plant.—In the powerhouse there is located the main power-generating apparatus for supplying light, heat and power to all departments of the Institute. The equipment here consists of: two 250-horsepower Heine water tube boilers, one equipped with a Jones stoker and one with Perfection grate, a 300-horsepower Aultman & Taylor horizontal water tube boiler, equipped with United States rocking grates, two boiler feed pumps—one a Knowles and the other a Deane—a 40,000-pound Cochrane metering open-feed heater, which is provided with a Lea recorder, and a Cochrane oil extractor which heats and measures all feed water, a 3-inch Venturi meter in feed line with indicating manometer as made by the Builders Iron Foundry, Providence, R. I. In the Engine Room are located: a Payne 14 by 14 automatic high speed engine, 125-horsepower

direct connected to 75-kilowatt, 220-volt, direct-current Bullock generator, a 9½ by 11 Nash gas engine of 50-horsepower, 4-cycle type, direct connected to a 30-kilowatt, 220-volt, direct-current Bullock generator, a 65-kilowatt motor generator set, consisting of a direct current motor and an alternating current generator made by the Westinghouse Electric and Manufacturing Company. A steam-driven Ingersoll-Rand 8 by 8 air compressor, for use with Turbo heads, installed in the French Spinning Department by the G. M. Parks Company, Fitchburg, Mass. The station switchboard is of marine-finished slate, 90 inches in height, and consists of three generator panels and two circuit panels.

The powerhouse is connected with the main school buildings by a tunnel through which all wires, steam and water pipes are carried.

GRADUATES WITH TITLES OF THESES

June 7, 1932

Bachelor of Textile Chemistry

As there has been a change during the past year in the curriculum of the Textile Chemistry and Dyeing Department and thesis is now optional, no thesis subjects have been listed.

Marie Gertrude Barry	Lowell
Arthur Leon Bertrand	Lowell
Leo Gleklen	Lynn
Joseph Edwin Hardman	Lowell
Stanley Squire Hockridge	North Adams
Lorne Fernley Howard	North Chelmsford
Daniel Joseph King	Lowell
Bessie Lifland	Roxbury
John Joseph McDonald, Jr.	Lowell
Barton Mathewman McQuaid	North Billerica
John Joseph Meehan	Lowell
Herbert Eugene Meinelt	Lawrence
Edward Francis Moran	Lowell
Anthony Orlauski	Haverhill
Hiag Nishan Piligian	Springfield
Arthur Ovila Spalding	Lowell
Francis Luke Toher	Lowell
Samuel J. Walker	East Liverpool, Ohio

Bachelor of Textile Engineering

Herbert Arthur Edward Bagshaw, Dracut, Mass. "An Investigation of the Possibility of Using the Verigraph to Determine the Regain of Fabrics."

Allan Campbell, Jr., South Boston, Mass. "The Effect of Regain upon the Strength and Elongation of Woolen Fabrics."

Thomas Dickson Ferguson, Jr., Lowell, Mass. "A Study of Tension during Ring Spinning and its Autographic Recording."

Joseph Glowacki, Andover, Mass. "A Determination of the Relation between the Breaking Strength and Elongation of Single and Two-ply Worsted Yarns."

Gerard John Joseph Hegy, Holyoke, Mass. "A Study of Bursting and Tensile Tests on Knitted Fabrics."

Francis Gerard McDougall, Lowell, Mass. "A Study of the Measurement of the Luster of Textile Fabrics."

Harold William Russell, Sanford, Maine. "An Investigation of the Walen Evenness Tester and the Possibilities of its Use in Determining the True Diameter and Uniformity of Single Yarns."

Henry Severance Sawyer, Dalton, Mass. "A Comparison of Mule and Ring Spun Woolen Yarns and the Fabrics Made therefrom."

Diploma Graduates

Cotton Manufacture

E-Zung Yung, Shanghai, China. "The Relation of Twist Multipliers for Maximum Strength and the Length of Staple Used in Spinning Cotton Yarns."

Textile Design

Edward Lucian Golec, Lowell, Mass. "Modification of Color Due to Textile Processes."

Albert William Williams, Lowell, Mass. "Manufacture and Designing of a Piece of Jacquard Drapery Fabric."

Prizes awarded in June, 1932

The Medal of the National Association of Cotton Manufacturers awarded to the student taking course in Cotton who maintains the highest average in scholarship throughout this course. To *Herbert Arthur Edward Bagshaw.*
Louis A. Olney Prizes (in the form of books).

$10 to the regular student of the Chemistry and Textile Coloring course who shall be considered as having attained the highest scholarship during his second year. To *Robert Theodore Graham.*

$5 to the regular student of the Chemistry and Textile Coloring course who shall be considered as having attained the second highest scholarship during his second year. To *Robert Joseph Thomas.* Honorable mention, *Kenneth Everett Leslie* and *Leon Eugene Moody.*

$10 to the student taking the regular Chemistry and Textile Coloring course who shall be considered as having attained the highest scholarship in first-year Chemistry. To *Joseph Shain.*

$5 to the student taking the regular Chemistry and Textile Coloring course who shall be considered as having attained the second highest scholarship in first-year Chemistry. To *James Campbell deGruchy, Jr.* Honorable mention, *Roland Joseph Gagnon, Ernest Lorenzo Dion* and *George Robert Thompson.*

REGISTER OF DAY STUDENTS

Candidates for Degree

Class of 1933

Home Address	*Lowell Address*
Babigan, Edward, IV, Lowell, Mass.	121 Bellevue Street
Burke, James Edward, IV, Lowell, Mass.	77 Durant Street
Dempsey, Philip Edward, IV, Monson, Mass.	Phi Psi House
Dudley, Albert Richard, VI, Lowell, Mass.	126 Coburn Street
Echecopar, Jesús Fortunato, VI, Lima, Peru	52 Mt. Washington Street
Forsythe, George, VI, Andover, Mass.	———
Glowienski, Mitchell, IV, Lowell, Mass.	198 West Sixth Street
Kokoska, Michael George, VI, Lowell, Mass.	120 Lakeview Avenue
Lifland, Moses, VI, Roxbury, Mass.	———
Markarian, Haig, IV, Lowell, Mass.	103 Lawrence Street
Matthews, Raymond Lewis, IV, Gardner, Mass.	Omicron Pi House
Murphy, John Joseph, IV, Lowell, Mass.	124 Liberty Street
Pizzuto, Joseph James, Jr., IV, Pittsfield, Mass.	65 Sterling Street
Raymond, Frank Everett, Jr., VI, Salem, Mass.	52 Mt. Washington Street
Recher, Theodore, VI, North Providence, R. I.	137 Riverside Street
Robillard, Gerald Adelbert, IV, Lowell, Mass.	889 Moody Street
Savard, Aimé Albert, IV, Lowell, Mass.	311 Mammoth Road
Shapiro, Simon, VI, Lowell, Mass.	84 Cambridge Street
Stearns, Kenneth Lawrence, IV, Lowell, Mass.	43 Grace Street
Turcotte, David Henry, IV, Lowell, Mass.	523 Fletcher Street
Wells, Henry Alfred, Jr., IV, Elizabeth, N. J.	37 Varney Street
Wojas, Stanley Edward, IV, Lowell, Mass.	24 Ray Court
Young, Edmund Joseph, Jr., IV, Lowell, Mass.	545 School Street

Class of 1934

Allen, Grover Stanley, IV, Haverhill, Mass.	———
Beigbeder, Edgar Raymond, IV, Roslindale, Mass.	Omicron Pi House
Birtwell, John Lincoln, IV, East Chelmsford, Mass.	———
Bradford, Edward Hosmer, VI, Andover, Mass.	———
Bukala, Mitchell John, IV, Lowell, Mass.	3 Osgood Avenue
Cowan, Raymond Bernard, IV, Haverhill, Mass.	28 White Street
Daley, Charles Lincoln, IV, Lowell, Mass.	239 Stevens Street
Diehl, Fred Anton, VI, East Paterson, N. J.	Phi Psi House
Donohoe, Edward Joseph, VI, Lowell, Mass.	49 Butterfield Street
Dunlap, Parker, VI, Billerica, Mass.	180 Pawtucket Street
Dunn, Austin Pember, VI, Shirley, Mass.	———
Fox, David James, VI, Lowell, Mass.	359 Beacon Street
Garner, John William, IV, Kezar Falls, Me.	Omicron Pi House
Gifford, Alden Ives, Jr., VI, Lowell, Mass.	18 Marlborough Street
Gillespie, Francis Clifford, IV, North Andover, Mass.	———
Graham, Robert Theodore, IV, North Andover, Mass.	———
Gregory, Robert Crockett, VI, Rockland, Me.	Omicron Pi House
Hallissy, John Joseph, VI, Manchester, Mass.	Phi Psi House
Henderson, Robert James, IV, Swampscott, Mass.	Omicron Pi House
Kidder, Glen Mortimer, IV, Ayer, Mass.	———
Lauder, Robert William, VI, Haverhill, Mass.	Omicron Pi House
Lawson, Russell Munroe, VI, Andover, Mass.	———
Leblanc, Gerald Alderic, VI, Lowell, Mass.	86 White Street
Leslie, Kenneth Everett, IV, Haverhill, Mass.	———

Home Address	*Lowell Address*
Moody, Leon Eugene, IV, Lowell, Mass.	33 WestTenth Street
Morrison, Roland Charles, IV, Dracut, Mass.	———
Phelan, Leonard John, IV, Ipswich, Mass.	137 Riverside Street
Shah, Shantilal Hiralal, IV, Bombay, India	53 Mt. Hope Street
Smith, Harold, IV, Lowell, Mass.	24 Belmont Street
Thomas, Benjamin, Jr., VI, Nashua, N. H.	———
Thomas, Robert Joseph, IV, Lowell, Mass.	24 Loring Street
Wilkie, Robert Campbell, VI, Newton Center, Mass.	Omicron Pi House
Wynn, William Joseph, Jr., IV, Lowell, Mass.	4 Ames Place

Class of 1935

Abrahamian, Aram, IV, Watertown, Mass.	———
Alcott, Albert Stephen, Jr., IV, Lowell, Mass.	59 Canton Street
Beattie, John Silas, IV, Lowell, Mass.	285 Foster Street
Bliss, Dorothy Myrtle, IV, Chelmsford, Mass.	———
Bogdan, John Francis, VI, Nashua, N. H.	———
Burke, Joseph Thomas, VI, Lowell, Mass.	109 Tyler Park
Cobb, Joseph Calvin, VI, Lowell, Mass.	5 Dover Street
Cogswell, Frederick William, IV, Maynard, Mass.	———
Connolly, Daniel Francis, Jr., VI, Salem, Mass.	Phi Psi House
Curtin, William John, IV, Lowell, Mass.	49 Second Street
deGruchy, James Campbell, Jr., IV, Stoneham, Mass.	———
Dion, Ernest Lorenzo, IV, Lawrence, Mass.	———
Echavarria, Luis, VI, Medellin, Colombia	100 Riverside Street
Eismann, Edmund, IV, Pawtucket, R. I.	9 White Street
Fairbanks, Evan Hobbs, VI, Wakefield, Mass.	———
Freeman, Arthur Samuel, VI, Chelsea, Mass.	28 White Street
Gagnon, Roland Joseph, IV, Lowell, Mass.	279 Liberty Street
Greenbaum, Hyman Herbert, IV, Haverhill, Mass.	———
Griffin, Vernon Harcourt, IV, Swampscott, Mass.	———
Grossman, Edward, VI, Providence, R. I.	28 White Street
Harwood, Ralph, IV, Bronx, N. Y.	28 White Street
Heffernan, John Vincent, IV, North Smithfield, R. I.	Phi Psi House
Holden, Arthur Newton, VI, North Billerica, Mass.	———
Jarek, Walter Julius, IV, Lowell, Mass.	74 Eleventh Street
Jurewicz, Brones Joseph, IV, Lowell, Mass.	448 Lawrence Street
Kennedy, Robert Miller, VI, Dunstable, Mass.	———
Kopatch, Chester Marion, IV, Lawrence, Mass.	———
Lokur, Swamirao Ramrao, B.S., IV, Ahmedabad, India	53 Mt. Hope Street
Moreno, Emilio Gomez, Jr., VI, Graniteville, Mass.	———
Parechanian, James Humphrey, IV, Lowell, Mass.	1 Summer Court
Plovnick, Max David, IV, Roxbury, Mass.	28 White Street
Poremba, Leo Louis, IV, Lowell, Mass.	4 Oak Street
Schaller, Joseph Gregory, IV, Wellesley, Mass.	11 White Street
Schoelzel, Herman Walter, IV, Methuen, Mass.	———
Shain, Joseph, IV, Roxbury, Mass.	———
Stein, William Joseph, VI, East Haven, Conn.	28 White Street
Stolzberg, Howard Nathaniel, IV, Haverhill, Mass.	28 White Street
Storey, Edwin Gerald, VI, Chatham, N. J.	43 Plymouth Street
Sullivan, Joseph Augustus, VI, Lowell, Mass.	28 Grove Street
Thompson, George Robert, IV, Lowell, Mass.	39 Roper Street
Thompson, Henry Albert, IV, North Tewksbury, Mass.	———

Class of 1936

Anthony, Henry Steere, IV, Lowell, Mass.	20 Loring Street
Athanasopoulos, Louis Peter, VI, Lowell, Mass.	240 Adams Street
Atteridge, Charles Joseph, IV, Providence, R. I.	43 Plymouth Street
Basdikis, Charles Apostolos, IV, Lowell, Mass.	8 Lagrange Street
Bates, Wesley Elliot, VI, East Milton, Mass.	———
Berg, Abraham David, VI, Brooklyn, N. Y.	28 White Street
Clarke, John Thomas, VI, Chelmsford, Mass.	———
Crawford, Robert Thomas, VI, Boston, Mass.	———
Dale, John Harold, Jr., IV, Billerica, Mass.	———
Duggan, Donald Francis, IV, Lowell, Mass.	334 Stevens Street
Finlay, Harry Francis, Jr., IV, Holbrook, Mass.	Omicron Pi House
Fuller, Roland Monroe, VI, Tewksbury, Mass.	———
Georgacoulis, George, IV, Lowell, Mass.	336 Suffolk Street
Hirsch, Emanuel Herman, VI, Weehawken, N. J.	9 White Street
Hodgman, Richard Albert, VI, Stoneham, Mass.	———
Holgate, Benjamin Alexander, VI, Lowell, Mass.	97 Grove Street
Jessen, Robert Frederick, IV, Whitinsville, Mass.	137 Riverside Street
Johnston, Lee Gale, IV, Haverhill, Mass.	———
Kaiser, John Raymond, VI, Bloomfield, N. J.	65 Sterling Street
Kennedy, Robert Gilman, IV, Lowell, Mass.	223 Pine Street
Klueber, William Tobias, IV, Haverhill, Mass.	———
Lambert, Corliss Bancroft, VI, Tyngsborough, Mass.	———
Landau, David, IV, Brooklyn, N. Y.	28 White Street
Langis, Paul Henri, IV, Lowell, Mass.	115 Mt. Washington Street
LeBel, Claude Merwin, VI, New York, N. Y.	43 Plymouth Street
Leonard, William Wheeler, Jr., IV, Norwich, Conn.	Omicron Pi House
Lincoln, Charles Ernest, IV, Mattapan, Mass.	———
Luescher, Frank Oscar, IV, Pawtucket, R. I.	9 White Street
Markarian, Moushy, IV, Lowell, Mass.	103 Lawrence, St.
Montminy, Leonce Peter, IV, Lowell, Mass.	723 Moody Street
Moore, Gerald Kingston, VI, Lowell, Mass.	964 Middlesex Street
Muller, Paul John, VI, Weehawken, N. J.	43 Plymouth Street
Olcott, Harry Depew, IV, Lowell, Mass.	56 Montview Avenue
Olshinski, Matthew John, VI, North Chelmsford, Mass.	———
Papaconstantinou, Fotoula Argyres, IV, Lowell, Mass.	798 Rogers Street
Redmond, James Reynolds, IV, Lowell, Mass.	84 Bartlett Street
Roach, Alton Chester, IV, Brookville, Mass.	37 Varney Street
Roarke, John James, IV, Lowell, Mass.	75 Viola Street
Robinson, William Harcourt, VI, Toronto, Ont.	53 Mt. Hope Street
Tyler, Bernard James, IV, Lowell, Mass.	30 Epping Street
Tyler, Stanley Noyes, VI, Lowell, Mass.	338 Fairmount Street
Urbanetti, Anthony Joseph, IV, South Manchester, Conn.	65 Sterling Street
Valentine, Preston Sumner, IV, Wayland, Mass.	53 Mt. Hope Street
Welch, William Paul, IV, Lowell, Mass.	76 South Highland Street
Wormwood, Herbert Alvin, IV, Andover, Mass.	———

Diploma Students

Class of 1933

Brown, William Alden, II, Norway, Me.	Phi Psi House
Crane, Eugene Francis, II, Lowell, Mass.	517 Westford Street
Morse, Judson Pickering, II, Danvers, Mass.	Phi Psi House
Penney, Cabot William, III, Methuen, Mass.	———
Stevens, William Edwin, I, West Warwick, R. I.	137 Riverside Street

Class of 1934

Bridges, Herbert Gardner, II, South Weymouth, Mass.	137 Riverside Street
Doyle, Kenneth Barr, II, Stafford, Conn.	Phi Psi House
Garbutt, William Alton, II, Worcester, Mass.	Phi Psi House
Huyck, William Francis, II, Lowell, Mass.	157 Nesmith Street

Class of 1935

Blanchard, Richard Moores, III, North Tewksbury, Mass.	———
Bogacz, John, III, Lowell, Mass.	53 Melrose Avenue
Boynton, Bradford Lewis, II, Andover, Mass.	———
Conant, Gilman Wright, II, Newton, Mass.	100 Riverside Street
Cwiklik, John Edward, III, Lowell, Mass.	84 Common Street
Darling, George Winfred, II, Southbridge, Mass.	137 Riverside Street
Salpas, Cosmos George, III, Lowell, Mass.	232 Adams Street

Special Students

Baranowski, John, III, Lowell, Mass.	4 Joiners Court
Blomberg, Gunnar Gustave, III, Milton, Mass.	———
Dupuis, Lucien Robert, III, Lewiston, Maine	358 Moody Street
Fenn, Harris Benjamin, Jr., IV, Ridgewood, N. J.	Omicron Pi House
Gleklen, Leo, B.T.C., II, Lynn, Mass.	28 White Street
Golec, Edward Lucian, III, Lowell, Mass.	117 Coburn Street
Greenberg, Benjamin, III, Waltham, Mass.	———
Hegy Gerard John Joseph, B.T.C., IV, Holyoke, Mass.	106 Crawford Street
Leary, Edward Warren, VI, Lowell, Mass.	249 East Merrimack Street
Lee, Roland Linwood, Jr., M.S., VI, Clemson College, South Carolina	11 White Street
Perkins, Orin John, III, South Lawrence, Mass.	———
Small, Raymond Lionel, IV, Waterville, Maine	Omicron Pi House
Weil, Everett Victor, A.B., III, New York, N. Y.	———

ALPHABETICAL LIST OF GRADUATES

The following list has been corrected in accordance with information received previous to February 1, 1933. Any information regarding incorrect or missing addresses is earnestly solicited.

B.T.C. indicates the degree of Bachelor of Textile Chemistry; B.T.D. indicates the degree of Bachelor of Textile Dyeing; B.T.E. indicates the degree of Bachelor of Textile Engineering; D indicates a diploma; C indicates a certificate (covering a partial course only). Degrees were issued beginning with the year 1913.

Abbot, Edward Moseley, II, '04 (D). Manufacturer, Abbot Worsted Company, Graniteville, Mass.

Abbott, George Richard, II, '08 (D). Andover, Mass.

Adams, Floyd Willington, VI, '16 (B.T.E.).

Adams, Henry Shaw, I, '05 (D). Assistant Treasurer, Aragon-Baldwin Cotton Mills, Chester, S. C.

Adams, Tracy Addison, IV, '11 (D). Vice-President and General Manager, Arnold Print Works, North Adams, Mass.

Albrecht, Charles Henry, IV, '17 (B.T.C.). 155 Central Street, Auburn, Mass.

Allard, Edward Joseph, IV, '31 (B.T.C.). Chemist, National Aniline & Chemical Company, Boston, Mass.

Almquist, George John Edwin, I, '19 (D). Second Vice-President, Passaic-Bergen Lumber Company, Passaic, N. J.

Anderson, Arthur Illman, IV, '24 (B.T.C.). Associate, Department of Research, Laundry-owners National Association, Joliet, Ill.

Anderson, Arthur Julius, IV, '19 (B.T.C.). Salesman, National Aniline and Chemical Company, 40 Rector Street, New York City.

Anderson, Clarence Alfred, VI, '25 (B.T.E.). 51 Winslow Avenue, Norwood, Mass.

Anderson, Harold Robert, II, '26 (D). Research Department, Abbot Worsted Company, Forge Village, Mass.

Annan, David, II, '23 (D). 105 Almont Street, Winthrop, Mass.

Arienti, Peter Joseph, IV, '10 (D). Chief Chemist and Dyer, Sayles Finishing Plants, Inc., Saylesville, R. I.

Arundale, Henry Barnes, II, '07 (D). Textile Analyst for G. H. Heath & Co., Ltd., Macclesfield, England, East Orange, N. J.

Atwood, Henry Jones, II, '23 (D). Assistant Superintendent, Daniels Manufacturing Company, East Brookfield, Mass.

Babb, Charles Wilkes, Jr., II, '31 (D). With Knox Woolen Company, Camden, Maine.

Babigan, Raymond, IV, '24 (B.T.C.). Patent Examiner, United States Patent Office, Washington, D.C.

Bachelder, Charles Edward, IV, '24 (B.T.C.). Supervisor of Textile Department, Tennessee Eastman Corporation, Kingsport, Tenn.

Bagshaw, Herbert Arthur Edward, VI, '32(B.T.E.) 92 Jenness Street, Lowell, Mass.

Bailey, Joseph W., I, '99 (D). Agent, Booth Manufacturing Company, New Bedford, Mass.

Bailey, Lester Harold, IV, '24 (B.T.C.). Chemist, Slater Company, Inc., Webster, Mass.

Bailey, Walter James, IV, '11 (D). Bailey's Cleansers and Dyers, Watertown, Mass.

Baker, Franz Evron, VI, '26 (B.T.E.). Instructor, Cotton Yarn Department, Lowell Textile Institute, Lowell, Mass.

Baker, Maurice Sidney, IV, '25 (B.T.C.). Merchant, Fine's, Attleboro, Mass.

Baker, William John, IV, '16 (D). Supervisor, Du Pont Rayon Company, Old Hickory, Tenn.

Baker, William Samuel, I, '26 (D). Assistant Systemizer, Nashua Manufacturing Company, Nashua, N. H.

Balch, Ralph Herman, VI, '29 (B.T.E.). Celanese Corporation of America, Amcelle, Md.

Baldwin, Frederick Albert, II, '04 (D). Vice-President and Secretary, Walter Blue & Co., Ltd., Sherbrooke, Que.

Bard, Morry Arnold, IV, '30 (B.T.C.). Chemist and Assistant Dyer, Pohatcong Hosiery Mills, Inc., Washington, N. J.

Barlofsky, Archie, VI, '17 (B.T.E.). Lawyer, Barlofsky & Barlofsky, Lowell, Mass.

Barr, I. Walwin, I, '00 (D). Second Vice-President, Buckley Brothers Company, 881 Broadway, New York City.

Barrett, Andrew Edward, IV, '23 (B.T.C.). Field Engineer, Armour & Co. (Industrial Soap Division), North Bergen, N. J.

Barry, Leo Joseph, II, '27 (D). With the Bell Company, Worcester, Mass.

Barry, Marie Gertrude, IV, '32 (B.T.C.). 31 Hoyt Avenue, Lowell, Mass.

Bauer, Harold Conrad, III, '28 (D). Assistant Designer, Merrimac Mills, Methuen, Mass.

Beck, Frederic Christian, II, '24 (D). In business, Weld & Beck, Southbridge, Mass.

Beeman, Earl, VI, '30 (B.T.E.). Research Department, Pacific Mills, Lawrence, Mass.

Bell, Edward Benjamin, IV, '24 (B.T.C.). Overseer of Dyeing, Malden Spinning & Dyeing Co., Malden, Mass.

Bennett, E. Howard, II, '03 (C). Publisher, Frank P. Bennett & Co., 530 Atlantic Avenue, Boston, Mass.

Bentley, Byron, II, '26 (D). With Joseph Bentley Hair Company, Methuen, Mass.

Bergeron, Alvin Wilfred, IV, '29 (B.T.C.). Textile Chemist, Celanese Corporation of America, Amcelle, Md.

Berry, Wilbur French, II, '17 (D). With Wilbur Manufacturing Company, Woonsocket, R. I.

Bertrand, Arthur Leon, IV, '32 (B.T.C.). 27 West Fifth Street, Lowell, Mass.

Bienstock, George Jerrard, III, '24 (D). Research Director and Woolen Stylist, The Bloch Company, Cleveland, Ohio.

Billings, Borden Dickinson, I, '29 (D). Industrial Engineer, Weybosset Mill, Providence, R. I.

Bird, Clarence Henry, II, '22 (D). Superintendent, George E. Duffy Manufacturing Co., Worcester, Mass.

Bird, Francis John, VI, '22 (B.T.E.). 30 West Street, Attleboro, Mass.

Blaikie, Howard Mills, II, '11 (D). 17 Maywood Avenue, Maywood, N. J.

Blake, Parker Gould, VI, '14 (D). District Manager, Claude Denis & Co., Ltd., Toronto, Ont.

Blanchard, John Lawrence, II, '23 (D). Designer, Farnsworth Company, Lisbon Centre, Me.

Bodwell, Henry Albert, II, '00 (D). With Ludlow Manufacturing Associates, 80 Federal Street, Boston, Mass.

Booth, James Mooney, IV, '24 (B.T.C.). Salesman, The Huron Milling Company, Inc., 9 Park Place, New York City.

Bottomley, John, III, '28 (D). Assistant Designer, Amoskeag Manufacturing Company, Manchester, N. H.

Boyd, George Andrew, I, '05 (D). Treasurer, Worcester Bleach & Dye Works Co., Worcester, Mass.

Brackett, Martin Richard, II, '22 (D). Member of firm, J. K. Taylor & Co., 450 7th Avenue, New York City.

Bradford, Harold Palmer, II, '25 (D). 90 Beach Street, Malden, Mass.

Bradford, Roy Hosmer, II, '06 (D). Textile Machinery, 161 Devonshire Street, Boston, Mass.

Bradford, William Swanton, VI, '31 (B.T.E.). Woolen Division, Lawrence Manufacturing Company, Lowell, Mass.

Bradley, Raymond Frost, VI, '14 (D). Garage Proprietor, Twin Light Garage, 267 East Main Street, Gloucester, Mass.

Bradley, Richard Henry, V, '01 (C). Gasoline Salesman, Fairhaven, Mass.

Brainerd, Arthur Travena, IV, '09 (D). Manager, Ciba Company, 325 West Huron Street, Chicago, Ill.

Brainerd, Carl Emil, IV, '20 (B.T.C.). Overseer of Dyeing, F. C. Huyck & Sons, Albany, N. Y.

Brandt, Carl Dewey, VI, '20 (B.T.E.). Head of Textile Engineering Department, Texas Technological College, Lubbock, Texas.

Brannen, Leon Vincent, III, '07 (C).

Brickett, Chauncy Jackson, II, '00 (D). Director, School of Textile Manufacturing and Designing, International Correspondence School, Scranton, Pa.

Brickett, Raymond Calvin, II, '14 (D). Overseer, M. T. Stevens & Sons Company (Marland Mills), Andover, Mass.

Brigham, Howard Mason, VI, '24 (B.T.E.). Salesman, Wellington, Sears & Co., 65 Worth Street, New York City.

Bronson, Howard Seymour, II, '27 (D). Overseer of Knitting, Portage Hosiery Company, Portage, Wis.

Brosnan, William Francis, IV, '27 (B.T.C.). Vice-President and General Manager, Antipyros Company, 338 Berry Street, Brooklyn, N. Y.

Brown, Gerald Marston, VI, '22 (B.T.E.).

Brown, Philip Franklin, II, '23 (D). District Sales Manager, DuPont Rayon Company, 350 Fifth Avenue, New York City.

Brown, Rollins Golthwaite, IV, '12 (D).

Brown, Russell Lee, VI, '21 (B.T.E.). Assistant Professor, Department of Woolen Yarns, Lowell Textile Institute, Lowell, Mass.

Brown, Will George, Jr., IV, '22 (B.T.C.). Chemist, American Hide & Leather Company, Lowell, Mass.

Buchan, Donald Cameron, II, '01, (D). Assistant Superintendent, M. T. Stevens & Sons Company, North Andover, Mass.

Buchan, Norman Spaulding, IV, '26 (B.T.C.). Overseer of Dyeing, Pitman Manufacturing Company, Laconia, N. H.

Burbeck, Dorothy Maria, IV, '20 (B.T.C.). See Garlick, Mrs. Dorothy M.

Burger, Samuel Joseph, III, '24 (D). President, Heat Maintenance Service, Inc., Brooklyn, N. Y.

Burnham, Frank Erwin, IV, '02 (D). Chemist and Dyer, Henry Klous Company, Lawrence, Mass.

Burns, Robert, IV, '28 (B.T.C.). Chemist, Celanese Corporation of America, Amcelle, Md.

Burtt, Joseph Frederic, VI, '31 (B.T.E.). Lowell Silk Mills, Lowell, Mass.

Buzzell, Harry Saville, VI, '29 (B.T.E.). Foreman of Raw Materials Laboratory, Oxford Paper Company, Rumford, Maine.

Callahan, John Joseph, Jr., II, '26 (D). Chemical Technician, Technicolor Motion Picture Corporation, Boston, Mass.

Cameron, Elliott Francis, IV, '11 (D). Attorney-at-law, Willard, Allen and Mulkern, 100 Milk Street, Boston, Mass.

Campbell, Alexander, VI, '23 (B.T.E.). Mechanical Engineer, Charles T. Main, Inc., Engineers, 201 Devonshire Street, Boston, Mass.

Campbell, Allan, Jr., VI, '32 (B.T.E.). 601 East Eighth Street, South Boston, Mass.

Campbell, Louise Porter, IIIb, '03 (C). With Ginn & Co., 15 Ashburton Place, Boston, Mass.

Campbell, Orison Sargent, II, '03 (D). Manager, Consolidated Felts, Ltd., Kitchener, Ont.

Cannell, Philip Stuart, VI, '23 (B.T.E.). Industrial Engineer, J. & P. Coats, Inc., Pawtucket, R. I.

Carbone, Alfred John, IV, '31 (B.T.C.). Textile Chemist, American Woolen Company, Andover, Mass.

Carleton, Joseph Raddin, III, '30 (D). Assistant Designer, The Bridgeport Coach Lace Company, Chelsea, Mass.

Carr, George Everett, I, '05 (D). Industrial Engineer, C. F. Mueller Company, 180 Baldwin Avenue, Jersey City, N. J.

Carr, Paul Edward, II, '24 (D) Designer, Pondicherry Woolen Company, Bridgton, Me.

Carter, Robert Albion, IV, '02 (D). District Manager, Dyestuff Sales, E. I. du Pont de Nemours & Co., 1609 Palm St., Reading, Pa.

Carter, Russell Albert, II, '25 (D). With Thermo Mills, Inc., West Sand Lake, N. Y.

Cary, Julian Clinton, VI, '10 (D). Branch Manager, The American Mutual Liability Insurance Company, 12 Haynes Street, Hartford, Conn.

Casey, Francis Harold, IV, '31 (B.T.C.). General Cleansers and Dyers, Inc., Holyoke, Mass.

Caya, Ferdinand Joseph, IV, '22 (B.T.C.). Textile Chemist, Gotham Silk Hosiery Company, Inc., Wharton, N. J.

Chamberlin, Frederick Ellery, I, '03 (D). Overseer of Spinning, Monument Mills, Housatonic, Mass.

Chandler, Proctor, IV, '11 (D). Manager, Chandler Manufacturing Company, 56 Amherst Street, Cambridge, Mass.

Chang, Chi, VI, '23 (B.T.E.).

Chang, Wen Chuan, VI, '21 (B.T.E.). Dah Sung Cotton Mill No. 1, Nantung, Kiangsu, China.

Chapman, Leland Hildreth, VI, '24 (B.T.E.). Vice-Principal, Hingham High School, Hingham, Mass.

Chen, Shih Ching, IV, '22 (B.T.C.). Hou Sung Cotton Mill, Shanghai, China.

Chen, Wen-Pei, IV, '24 (B.T.C.).

Chisholm, Lester Bury, I, '11 (D). Textile Development, U. S. Rubber Company, Providence, R. I.

Church, Charles Royal, II, '06 (C).

Churchill, Charles Whittier, III, '06 (D). Manager, Churchill Manufacturing Company, Inc., Lowell, Mass.

Clapp, F. Austin, II, '04 (D). Insurance Broker, White Plains, N. Y.

Clark, Earl William, IV, '18 (B.T.C.). Salem Depot, N. H.

Clark, Thomas Talbot, II, '10 (D). President and Treasurer, Talbot Mills, North Billerica, Mass.

Clarke, George Dean, II, '21 (C). Dyer, Seamans & Cobb Thread Mills, Hopkinton, Mass.

Clayton, Harold Edmund, VI, '21 (B.T.E.). Manager, Brown Hosiery Company, Lowell, Mass.

Cleary, Charles Joseph, II, '13 (D). Textile Technologist, United States Army Air Service, Wright Field, Dayton, Ohio.

Clement, David Scott, IV, '24 (B.T.C.). Chemist, Nashua Manufacturing Company, Nashua, N. H.

Cleveland, Richard Sumner, VI, '30 (B.T.E.). Junior Textile Technologist, National Bureau of Standards, Department of Commerce, Washington, D. C.

Clifford, Albert Chester, VI, '22 (B.T.E.). Textile Engineer, Western Electric Company, Inc., Kearny, N. J.

Clogston, Raymond B., IV, '04 (D). Superintendent of Dyeing, Merrimack Manufacturing Company, Lowell, Mass.

Cluett, John Girvin, I, '29 (D). Textile Analyst and Assistant to Superintendent at Bleachery, Cluett, Peabody & Co., Inc., Peebles Island, Waterford, N. Y.

Coan, Charles Bisbee, IV, '12 (D.)

Coffey, Daniel Joseph, III, '28 (D). 128 Brown Street, Pittsfield, Mass.

Cohen, Arthur Edward, IV, '23 (B.T.C.)

Cohen, Raphael Edvab, IV, '25 (B.T.C.) Secretary and Sales Manager, Merrimack Paper Tube Company, Inc., Lowell, Mass.

Colby, J. Tracy, VI, '16 (D). Sales Manager, F. C. Huyck & Sons, Empire State Building, Room 3006, New York City.

Colby, Willard Alvah, Jr., IV, '30 (B.T.C.). Assistant Dyer, Utica Willowvale Bleaching Company, Chadwicks, N. Y.

Cole, Edward Earle, IV, '06 (D). Financial Agent, The Bradstreet Company, Boston, Mass.
Cole, James Thomas, II, '05 (D). 1357 Massachusetts Avenue, Lexington, Mass.
Collonan, Herbert Joseph, II, '22 (D). Moosup, Conn.
Coman, James Groesbeck, I, '07 (D). Manager Mexia Textile Mills, Mexia, Texas.
Conant, Harold Wright, I, '09 (D). Assistant Treasurer, United Elastic Corporation, Easthampton, Mass.
Conant, Richard Goldsmith, I, '12 (D). Sales Executive, Wellington, Sears & Co., 65 Worth Street, New York City.
Conklin, Jennie Grace, IIIb, '05 (C). See Nostrand, Mrs. William L.
Connor, Thomas Francis, II, '23 (D). North Cohasset, Mass.
Connorton, John Joseph, Jr., III, '27 (D). Head Designer, Amoskeag Manufacturing Company, Manchester, N. H.
Cook, Kenneth Bartlett, I, '13 (D). Technical Manager, Manville-Jenckes Company, Manville, R. I.
Corbett, James Francis, IV, '28 (B.T.C.). Chemist, Pacific Mills Print Works, Lawrence, Mass.
Cote, Theodore Charles, IV, '26 (B.T.C.). Chemist, Merrimack Manufacturing Company, Lowell, Mass.
Craig, Albert Wood, IV, '07 (D). Superintendent, Windsor Print Works, North Adams, Mass.
Craig, Clarence Eugene, III, '02 (D).
Creese, Guy Talbot, IV, '14 (D). Chemist, Creese & Cook Company, Danversport, Mass.
Crowe, Joseph Bailey, IV, '25 (B.T.C.). Textile Research Department, Proctor & Gamble Co., Ivorydale, Ohio.
Culver, Ralph Farnsworth, IV, '04 (D). Vice-President and Manager, Providence Office, Ciba Company, Inc., 61 Peck Street, Providence, R. I.
Cummings, Edward Stanton, VI, '16 (D). Industrial Engineer, with Ralph E. Loper & Co., Greenville, S. C.
Curran, Charles Ernest, III, '02 (C). Head Designer, Wood Worsted Mills, Lawrence, Mass.
Currier, Herbert Augustus, I, '06 (D). Vice-President, Waterman, Currier & Co., Inc., 40 Worth Street, New York City.
Currier, John Alva, II, '01 (D). Superintendent of Fabrics Department, Stevens Mills, North Andover, Mass.
Curtis, Frank Mitchell, I, '06 (D). Retail Lumber, Wm. Curtis Sons Company, 10 Blue Hill Avenue, Milton, Mass.
Curtis, William Leavitt, II, '05 (C.)
Cutler, Benjamin Winthrop, Jr., III, '04 (D). Department Manager, Worth Textile Company, 40 Worth Street, New York City.
Cuttle, James H., II, '99 (D). Vice-President, S. Stroock & Co., Inc., Newburgh, N. Y.

Dalton, Gregory Smith, IV, '12 (D).
Danahy, Arthur Joseph, IV, '31 (B.T.C.). 37 Clark Street, Lowell, Mass.
Darby, Avard Nelson, II, '28 (D). General Foreman, Plant No. 2, Merrimac Hat Corporation, Amesbury, Mass.
Datar, Anant Vithal, VI, '24 (B.T.E.). Secretary and Manager, The Pulgaon Cotton, Spinning, Weaving and Manufacturing, Co., Ltd., Pulgaon, C.P., India.
Davidson, Sydney, III, '28 (D). 64 Devon Street, Roxbury, Mass.
Davieau, Alfred Edward, VI, '16 (D). Textile Engineer, United States Testing Company, Inc., 316 Hudson Street, New York City.
Davieau, Arthur Napoleon, VI, '13 (D). Superintendent, Kenwood Mills, Ltd., (F. C. Huyck & Sons), Arnprior, Ont.
Davieau, Leon Arthur, VI, '23 (B.T.E.). With United States Rubber Company (Textile Section), Market and South Streets, Passaic, N. J.
Davis, Alexander Duncan, VI, '14 (B.T.E.). Instructor, Northeastern University, Springfield, Mass.

Dearborn, Roy S., VI, '13 (D). Salesman, Dumas & Co., Lowell, Mass.

Dearth, Elmer Elbridge, IV, '12 (D). General Plant Manager, The Fisk Rubber Company, Chicopee Falls, Mass.

Del Plaine, Parker Haywood, IV, '25 (B.T.C.). Southern Manager, Rohm & Haas Company, 1109 Independent Building, Charlotte, N. C.

Derby, Roland Everett, IV, '22 (B.T.C.). Chemist, M. T. Stevens & Sons Company, North Andover, Mass.

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Dewey, James French, II, '04 (D). President and Treasurer, A. G. Dewey Company, Quechee, Vt.

Dewey, Maurice William, II, '11 (D). With National Life Insurance Company, Montpelier, Vt.

Dillon, James Henry, III, '05 (D).

Dods, James Barber, II, '27 (D). Vice-President and General Manager, The Dods Knitting Company, Ltd., Orangeville, Ont.

Dolan, William Francis, IV, '28 (B.T.C.). Dyer, Lowell Bleachery South, Griffin, Ga.

Donald, Albert Edward, II, '04 (D). Agent, H. T. Hayward Company, Franklin, Mass.

Donovan, Joseph Richard, IV, '24 (B.T.C.).

Doran, Wilbur Kirkland, II, '22 (D).

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Harmon, Charles Francis, I, '99 (D).
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Harris, Charles Edward, I, '05 (D). Superintendent, Martin Rocking Fifth Wheel and Trailer Company, Westfield, Mass.
Harris, George Simmons, I, '02 (C). Red Cross Cotton Distribution, American Red Cross National Headquarters, Washington, D.C.
Harrison, Mrs. Arthur (Goodhue, Amy Helen), IIIb, '00 (C). R. F. D. No. 2, Lowell, Mass.

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Hart, Howard Roscoe, I, '23 (D). Superintendent, Aikens Mills Inc., Bath, S.C.
Haskell, Walter Frank, IV, '02 (D). Overseer of Dyeing, Dana Warp Mills, Westbrook, Maine.
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Howe, Woodbury Kendall, I, '10 (D). Assistant Superintendent, Merrimack Manufacturing Company, Lowell, Mass.

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Huising, Geronimo Huerva, I, '08 (D).

Hunt, Chester Lansing, III, '05 (C).

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Rivers, William Anthony, II, '24 (D).

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Wang, Cho, VI, '23 (B.T.E.).

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Warren, Philip Hamilton, II, '05 (D). Superintendent, Hopeville Manufacturing Company, Worcester, Mass.

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LOWELL TEXTILE INSTITUTE

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Date and Place of Birth ....

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  1. General Course
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  3. Wool Option
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- III. Textile Design

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Other High or Preparatory Schools attended...............................

If you have done collegiate work, give name and address of college or

university ....193.... —193....

Signature ....

Signatures of..

Parents or
Guardian...

Citizen of ....
City or Town *State*

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THE EFFECT OF REGAIN UPON THE PROPERTIES OF WOOLEN YARNS

BY HERBERT J. BALL, S. B., B. C. S., *Professor of Textile Engineering*

The material for this paper is selected from an undergraduate thesis performed under the direction of the Textile Engineering Department by J. F. Echecopar, 1933, as a partial requirement for the degree of Bachelor of Textile Engineering.

The purpose of the thesis was to ascertain the effect of regain upon the breaking strength and elongation of woolen yarns. There is reproduced here those results which it is believed will be most useful and interesting.

The material used consisted of six mule-spun woolen yarns secured from a nearby mill. The approximate run numbers were 0.6, 1, 1.5, 2, 3 and 5. The actual values are given in Table I. The 0.6-run yarn was made of Punta wool, the 1-run yarn from carpet noils, the 1.5 and 2-run yarns from B super and 1/4 blood noils, and the 5-run yarn from Fine A pulled wool.

Seven skeins of each yarn were prepared, degreased by thoroughly rinsing in gasoline, conditioned in a standard atmosphere for twenty-four hours, and weighed. The actual yarn number of each skein was computed from these weights.

The tests were conducted in a room equipped for automatic control of relative humidity. The temperature varied from 70° to 75°F. Seven relative humidities were selected ranging from approximately 35% to 95%, and were so chosen as to give nearly equal increments of regain. The skeins were conditioned for at least three hours before testing. The regain condition in a yarn at time of test was determined from a sample composed of portions of the broken test specimens capsuled during the test.

One hundred single strand tests for breaking strength and elongation were made on each skein. The machine used was of the pendulum type and of 1 kgm or 5 kgm capacity as needed. The initial distance between jaws was 25 cm., the speed of the lower jaw was 12 in. per min., and an initial load of 10 grams was applied to the specimen.

The average breaking strength from each skein was multiplied by its respective run number to secure a quantity designated as the strength factor. This may be regarded as the breaking strength, expressed in grams, for an equivalent 1-run yarn, or it may be considered as a quantity which is proportional to the breaking unit stress of the yarn itself.

Plots B, C, and D are graphical expressions of the results obtained from the 2-run yarn, and are typical of those for the other sizes. It was found in all cases that the plotted points could be satisfactorily averaged by straight lines, from the slopes of which the rate of change in strength factor, elongation, and relative humidity was determined. The results are expressed in Table I.

TABLE I

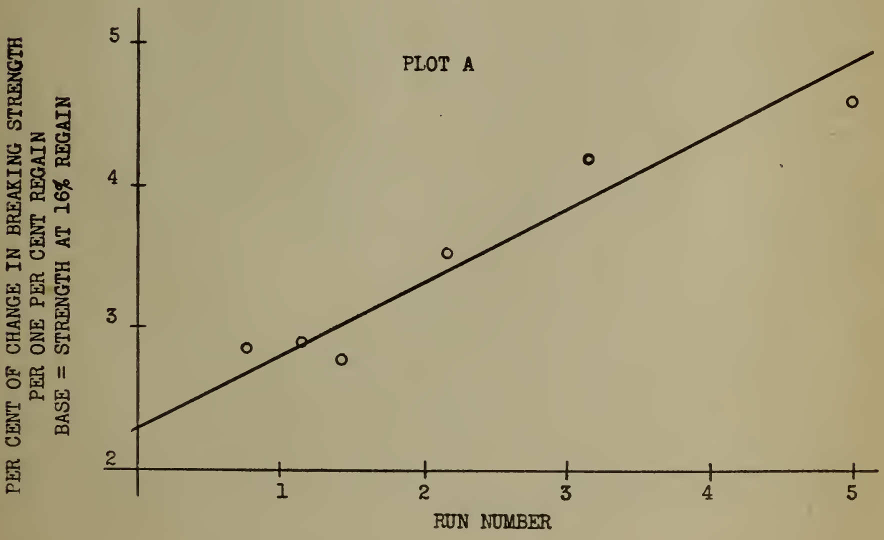
	Actual Run Numbers					
	0.74	1.15	1.43	2.14	3.12	4.98
Decrease in Str. Factor, grams per 1% regain	33	26	26	46	44	48
Increase in Elongation, per cent per 1% regain	2.0	2.0	1.6	1.9	2.1	2.4
Increase in Regain, per cent per 1% R. H.	0.15	0.14	0.15	0.17	0.21	0.22

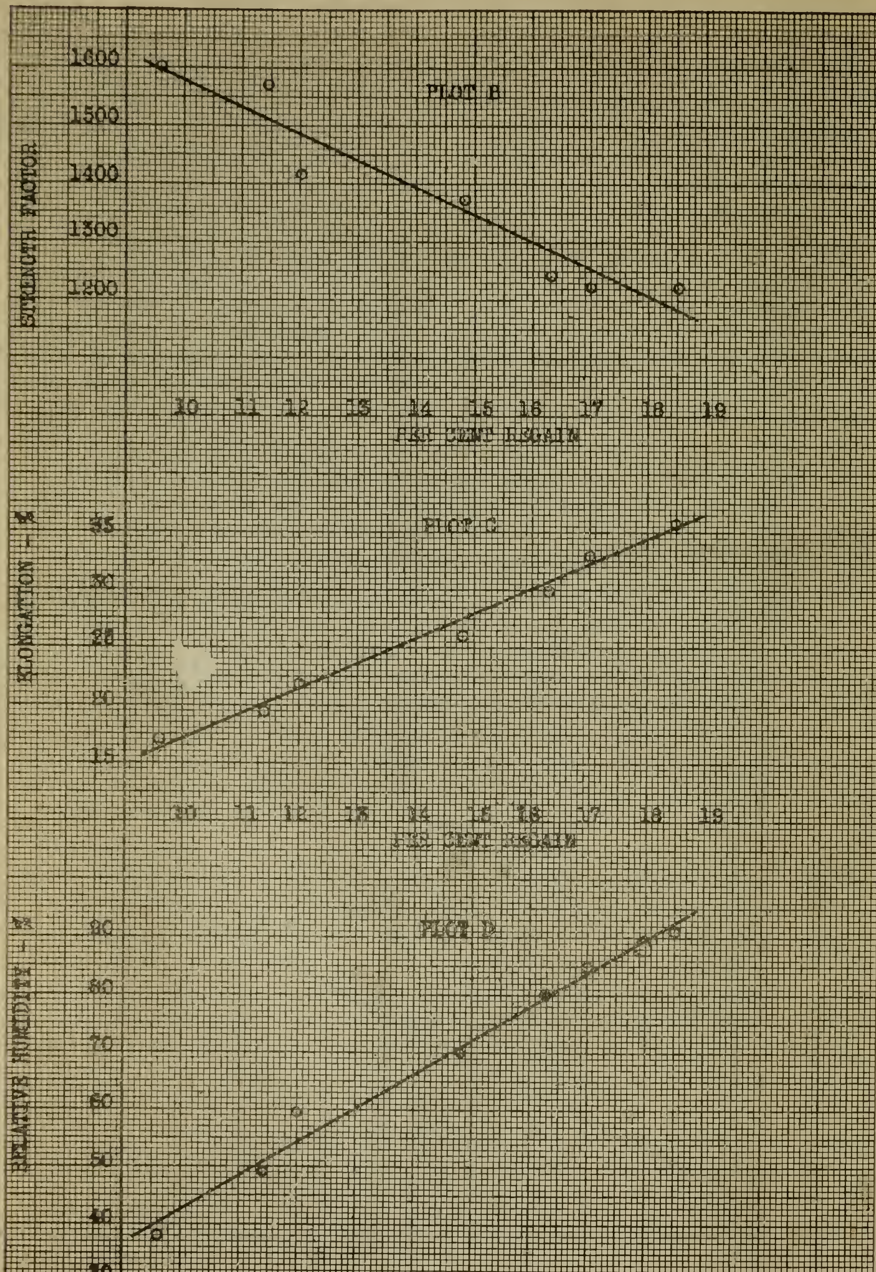
Any deductions drawn from the above values must of necessity be limited to the kinds of yarn used in these tests. With this in mind, the following generalizations may be made. (1) The rate of decrease in strength with increase in regain seems to increase as yarns become finer. (2) The rate of increase in per cent elongation with increase in regain seems to be nearly constant at 2% per 1% regain. (3) The rate of increase in regain with increase in relative humidity seems to increase as yarns become finer.

Plot A is a graph of the results obtained by expressing the values in the first line of the table as a percentage of the strength factor of each yarn at 16% regain. Assuming that the line represents a fair average of the plotted points, it is possible to derive the following relation from its equation:

$$\text{Rate} = -\ (0.5)\ (\text{Run number})\ -\ 2.25$$

where rate expresses the per cent of change in strength factor per one per cent of regain. It is to be noted that minus signs are used to indicate a decrease in strength. A further generalization may therefore be stated, namely, that as woolen yarns become finer there is a proportionate increase in their rate of decrease in strength with increasing regains.





PLOT B
STRENGTH FACTOR
1600
1500
1400
1300
1200
10 11 12 13 14 15 16 17 18 19
PER CENT REGAIN
PLOT C
ELONGATION - %
35
30
25
20
15
10 11 12 13 14 15 16 17 18 19
PER CENT REGAIN
PLOT D
RELATIVE HUMIDITY - %
90
80
70
60
50
40
30

5